DESIGN, CONSTRUCTION, OPERATION OF METAL-WORKING AND ALLIED EQUIPMENT

MACHINERY

APRIL, 1945

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The joining of metals by brazing and soldering is an art that has been practiced since the days of ancient history. Most of the early uses appear to have been for ornamentation and jewelry, whereas modern brazing is applied to many commercial products. Present-day brazing represents a great advance over the old methods. Research has recently developed a group of alloys that can be applied in a number of ways not possible with older materials. The leading article in May MACHINERY will outline the brazing alloys that are now commercially available and discuss present-day brazing possibilities.

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MACHINERY

Volume 51 Number 8 April, 1945

NEW Processes... NEW Products...

The necessities of wartime production have lent impetus to the development of many unique manufacturing processes and to the extensive application of some processes that are not exactly new but whose advantages were not fully recognized in pre-war days. Many of these developments will be utilized to their fullest extent only with the return of peace, when economical manufacture will again become a paramount consideration. Processes in this category are the precision casting of metal and the formation of parts from powdered metal within dimensional limits generally associated only with machining operations. These and other processes are treated comprehensively in this number of MACHINERY.

Ford Produces High-Speed Steel

An Unusual Application of the Waste Wax or Investment Method of Mold Making which has Enabled Large Economies to be Effected and which Points the Way to Many Post-War Applications

By CHARLES O. HERB

PRECISION casting, a manufacturing technique that was almost unknown to industry in general until World War II came along, has suddenly become an important production method for small, intricate parts. During this critical period, it has enabled great savings to be effected in tool-room time and actually has made possible the production of some parts that could not otherwise have been turned out. There are indications that this process will have considerable influence on product design within the immediate future. The making of high-speed steel cutters by precision casting—an unusual application of an unusual method—will be described in this article.

While this method, which is based on the use of wax patterns that can be dissipated from the molds, is new to the general metal-working industry, it has been employed for years in the jewelry field for producing objects with filigree and other fine detail. The process has also been widely used by firms making dentures. Casting from wax patterns, however, goes back way beyond modern times, having actually been practiced by the Chinese during the Shang Dynasty (1766-1122 B.C.) in the making of jewelry and objects of art, and even before that period by the ancient Egyptians.

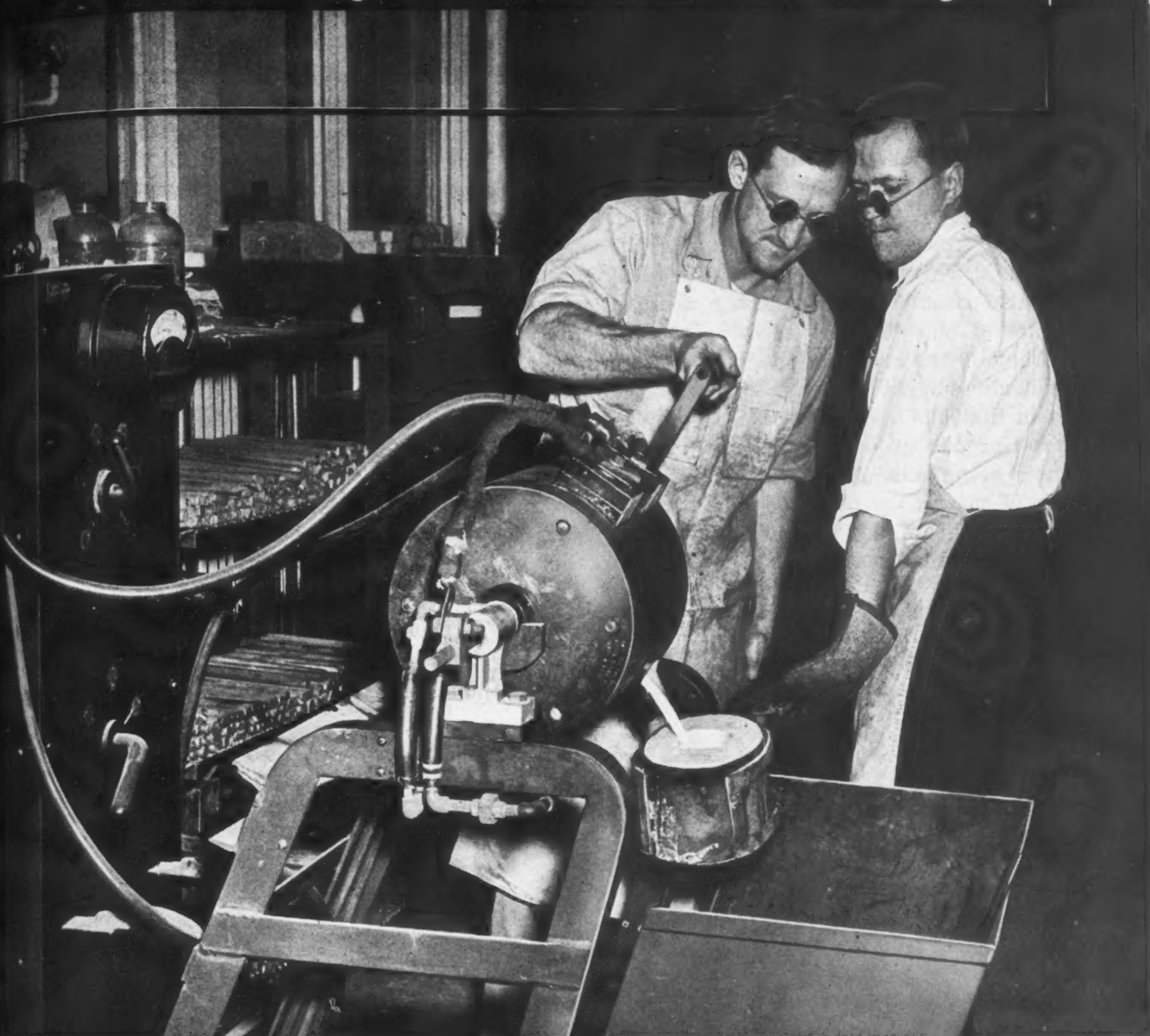
Precision casting, in brief, consists of using molds made of a fine refractory material that is poured around a pattern made from wax, plastic, or some other substance which can be melted and burnt away or vaporized without leaving any residue. By this method, molds can be constructed without any parting lines, which enables the castings to be produced so close to the required shapes that machining is seldom necessary. Of even greater importance is the fact that intricate parts can be cast to tolerances as close as one-half thousandth of an inch. Most metals can be cast by this method, including silicon bronzes and alloy steels of any composition. Parts weighing as much as 7 pounds are being produced successfully.

One of the most important wartime applications of precision casting has been in the production of thousands upon thousands of small buckets for the rotors of airplane turbo-superchargers. Although these buckets must be within plus or minus 0.0005 inch of the required size, they can be used as cast. The Austenal Laboratories, Inc., New York City, are given credit for having conceived this application of the process, although turbo-buckets are being cast by a number of concerns. The buckets are cast from Vitallium and Stellite. Today, precision casting is being used for the production of a wide variety of other parts.

When the Ford Motor Co., Dearborn, Mich., commenced the manufacture of turbo-superchargers, difficulties were experienced in obtaining precision-cast turbine rotor buckets in sufficient quantities to meet production schedules. Consequently, a small department was established in the Rouge plant for precision casting these buckets. This operation has now been terminated, but from the knowledge and experience gained while it was being carried out, the chemical engineering department felt that the process could be applied to casting high-speed steel cutters and thus effect large savings in a critical war material.

These experiments were completely successful, and as a result, more than 10,000 cutters have been produced in the Ford laboratory by precision casting for use in Ford machine shops.

Cutters by Precision Casting



Except for sharpening the cutting edges and grinding off risers, these cutters require no finishing. The bores are used as cast.

The economical and other advantages derived from this practice were considered so important that plans were developed some months ago for wider application in cutter production. A "pilot" plant is now in daily operation at Camp Legion on the outskirts of Dearborn, where veterans of World War II are being rehabilitated in a project sponsored by Henry Ford. Most of the disabled veterans are enrolled in a machine shop training course that is offered under the supervision of the Ford Trade School. These men have produced thousands of cutters by precision casting, ready for the tool-cribs of the Ford airplane engine building. The technique followed in this "pilot" plant will be described in the following.

The first step in producing the cast cutters is to make up a master pattern that is an exact replica of the cutter to be made. The pattern is made either from steel or bronze, and is machined so that it is slightly over size to compensate for the shrinkage that occurs during the various steps of the process.

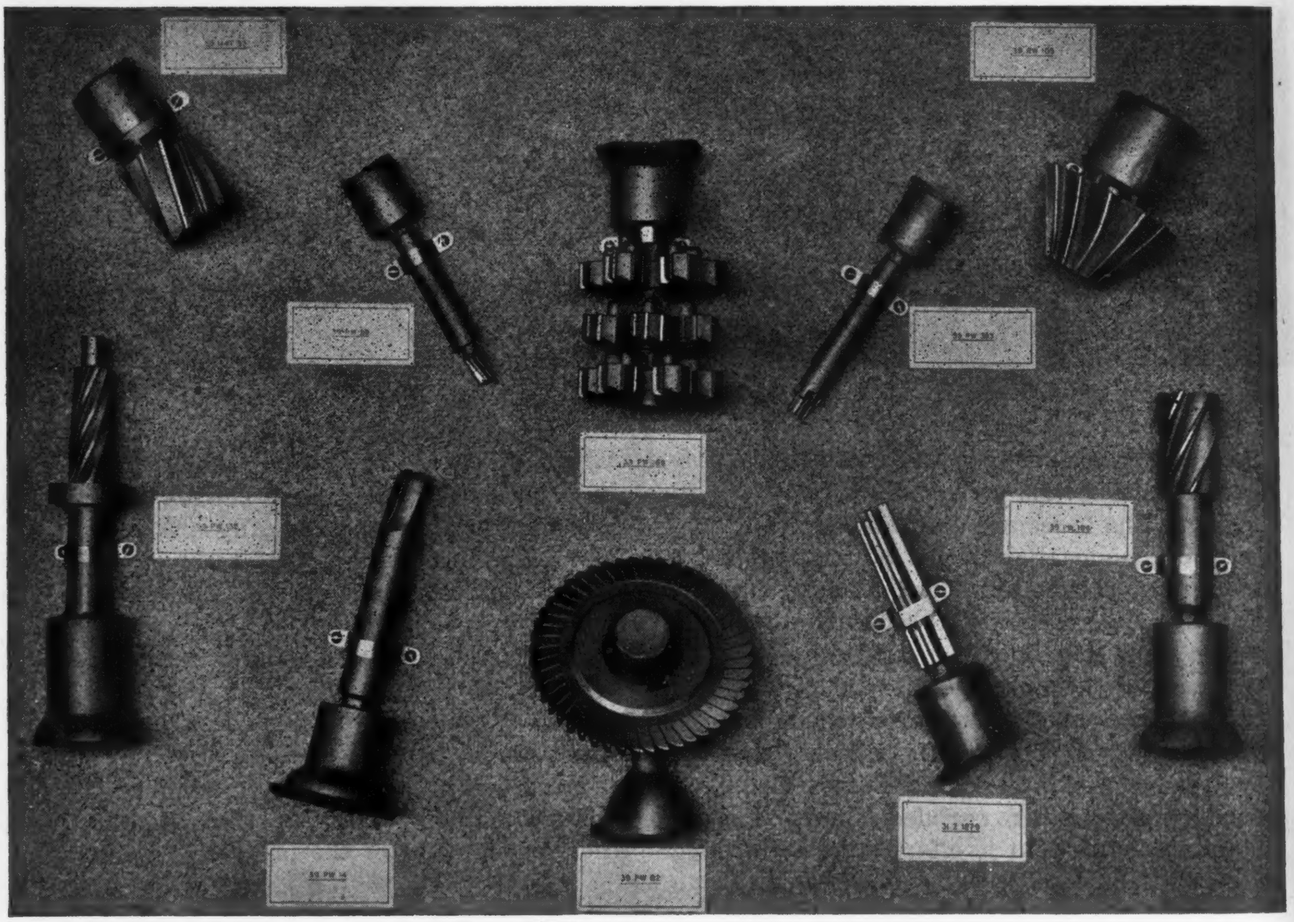
This master pattern is used to obtain a babbitt mold for use in producing a wax pattern. Other babbitt molds are used for producing wax risers, sprues, and runners. At the extreme left in Fig. 2 is shown a master pattern and, next to it, a babbitt mold that has been poured around this master pattern. Above and below the mold are steel plates for the top and bottom of the mold. Shown also are four long screws for holding these parts assembled. A steel plug mounted in the center of one plate serves as a core for forming a hole in the center of the wax pattern. To the immediate right of the mold parts is a wax pattern that has been formed in this mold.

The pattern molds are also made from plastic, such a mold being seen at the right in Fig. 3. Six inserts of plastic are mounted in a body of the same material. As many inserts as required can be made from one master pattern.

The forming of the wax pattern is one of the most important steps in the precision casting process, as upon the accuracy of the pattern details depends the preciseness of the cutter. In order to insure that the wax will fill tightly all sharp corners or under-cuts of the mold cavity, it must be injected into the babbitt mold under pressure. This is done by means of the press seen in Fig. 4, which utilizes air for forcing the wax into the babbitt mold, which is placed on the anvil beneath the press ram.

To the left of the press is seen an electrically heated portable pot in which the wax is melted ready for use in the grease guns. The temperature of this pot is automatically controlled by a thermostat. The wax is loaded into a cylinder for forcing into the mold at a consistency comparable to that of soft paste. To insure that this wax consistency will be maintained until

Fig. 1. High-speed Steel Cutters of Various Types, with Risers Still Attached, which were Produced by Precision Casting in Waste Wax Molds



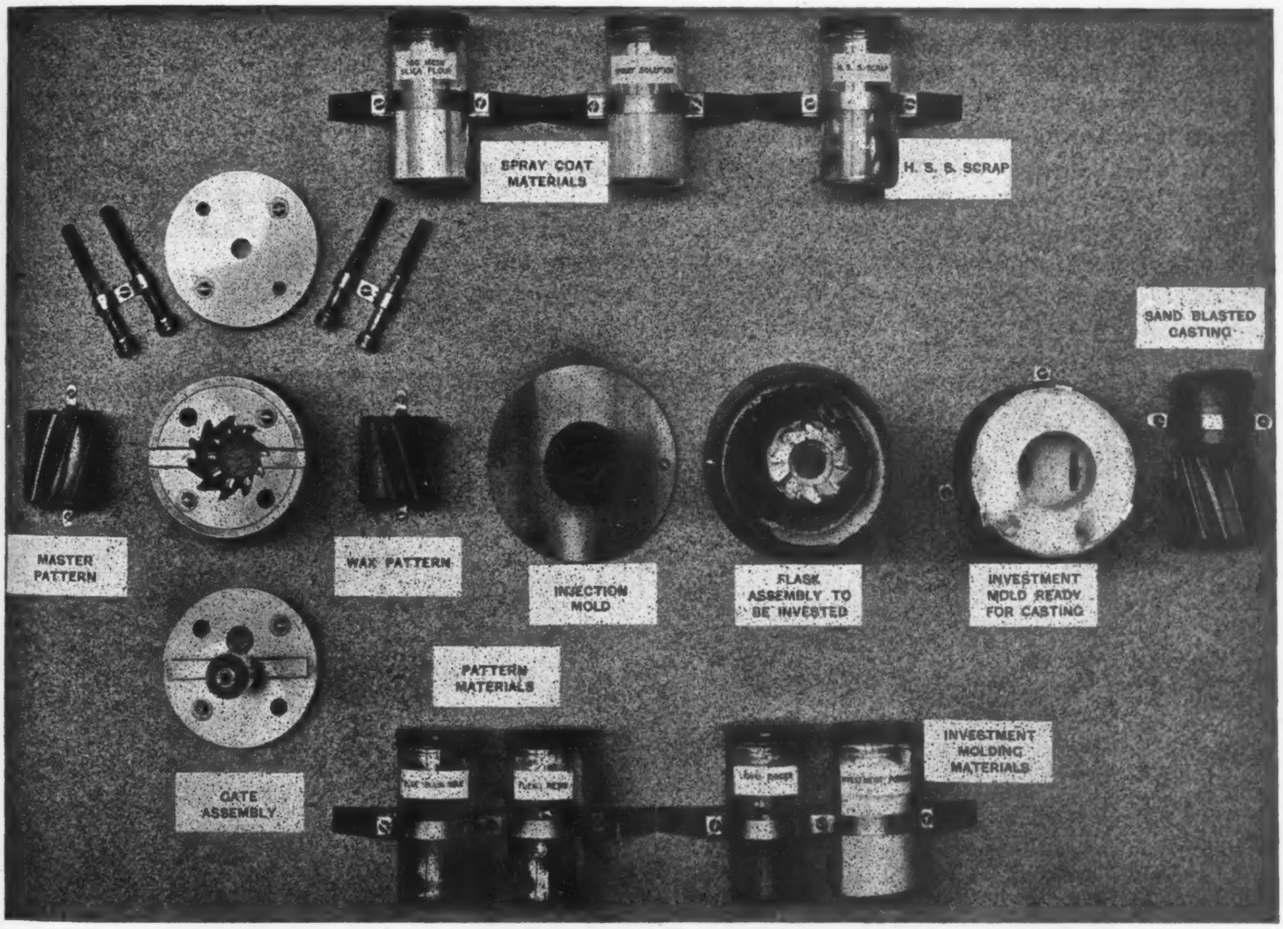
the pattern-molding operation is completed, a thermostat is connected to the cylinder. When the temperature of the wax is lowered to less than approximately 125 degrees F., an electric light bulb on the press column is lighted. This bulb remains on until the temperature has been raised to 135 degrees F.

The ram of the press (pneumatically operated) is equipped with a piston that is entered into the wax-loaded cylinder. When air is admitted to the cylinder behind the piston, the latter is moved downward, forcing the wax through the nozzle into the babbitt mold. When the mold has been filled, pressure is maintained on the wax long enough to insure that the mold cavity will remain tightly filled in spite of shrinkage. Air pressure is developed in a cylinder at the top of the press column by pumping a lever at the right of the press.

The kind of wax used for these patterns is a factor of prime importance in successful precision casting. Not only must the wax flow freely into the intricacies of the mold, but it must be of a type that will have sufficient strength when it has cooled to undergo subsequent handling. Literally hundreds of different wax combinations were tried out in the Ford laboratories before a proper mixture was adopted as standard practice. Different hardnesses are obtained by varying the proportions of the ingredients, and a different mixture must be used in summer and in winter. Some waxes used in the experiments were so brittle that they would break off when the investment mold with the wax pattern in it was shaken on a vibrating machine at the time that the investment mold was built up.

The wax patterns are readily removed from the babbitt molds by disassembling the molds

Fig. 2. Various Patterns and Molds Used in Precision Casting Cutters from High-speed Steel, and Materials from which Patterns, Molds, and Castings are Made



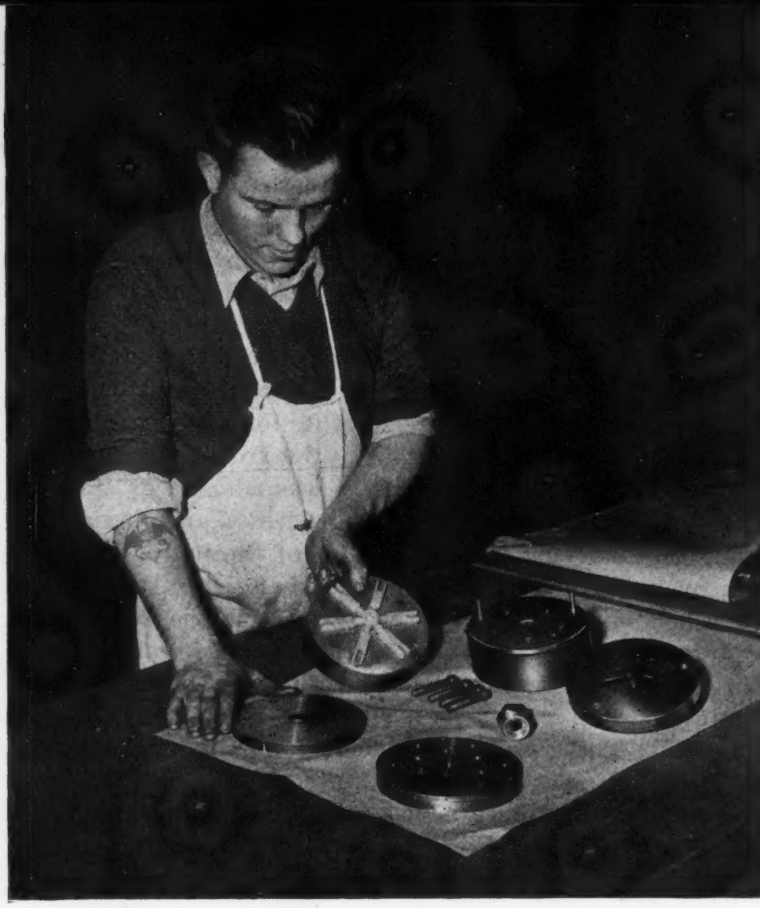


Fig. 3. (Left) Removing a Wax Pattern for Six Steadyrest Inserts from a Babbitt Mold; at the Right are Seen Two Sections of a Plastic Mold

Fig. 4. (Below) Wax having the Consistency of Soft Paste is Forced into a Babbitt or Plastic Mold by Means of an Air-operated Piston in a Wax-filled Cylinder to Form a Wax Pattern for the Precision Casting Process

and lifting out the pattern. In the case of patterns with helical flutes, it is necessary to swivel the pattern during its removal.

Risers of wax are attached to the pattern in an operation such as illustrated in Fig. 5. This is readily accomplished by melting the riser slightly with a heated iron and also the portion of the pattern to which the riser is to be attached, and then holding the two firmly together. When the melted wax solidifies, the riser and pattern become an integral part.

Several wax patterns can be combined in the same manner. In Fig. 5, for example, a man is seen building up a wax pattern for small steadyrest inserts by melting a small amount of wax on the bosses of the patterns and squeezing the pattern sections on rods of wax. The wax rods are harder than the patterns, as they must provide a rigid support for the pattern structure. They are made of 75 per cent blue bulk wax and 25 per cent Flexo resin. The wax pattern with the riser or sprue assembled is mounted on a

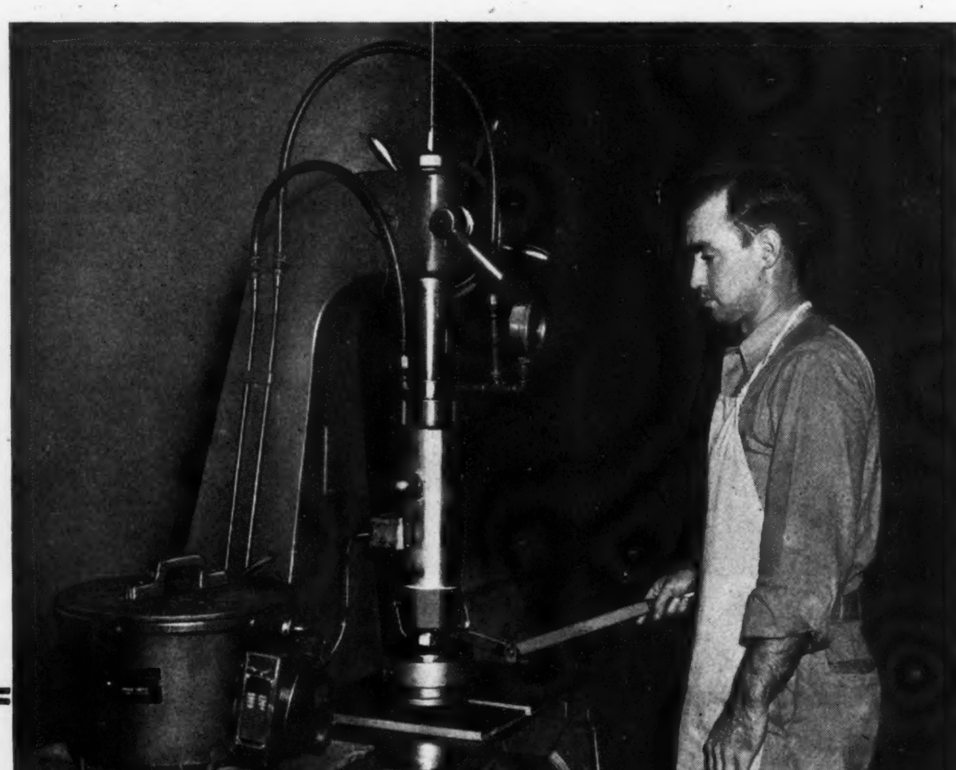


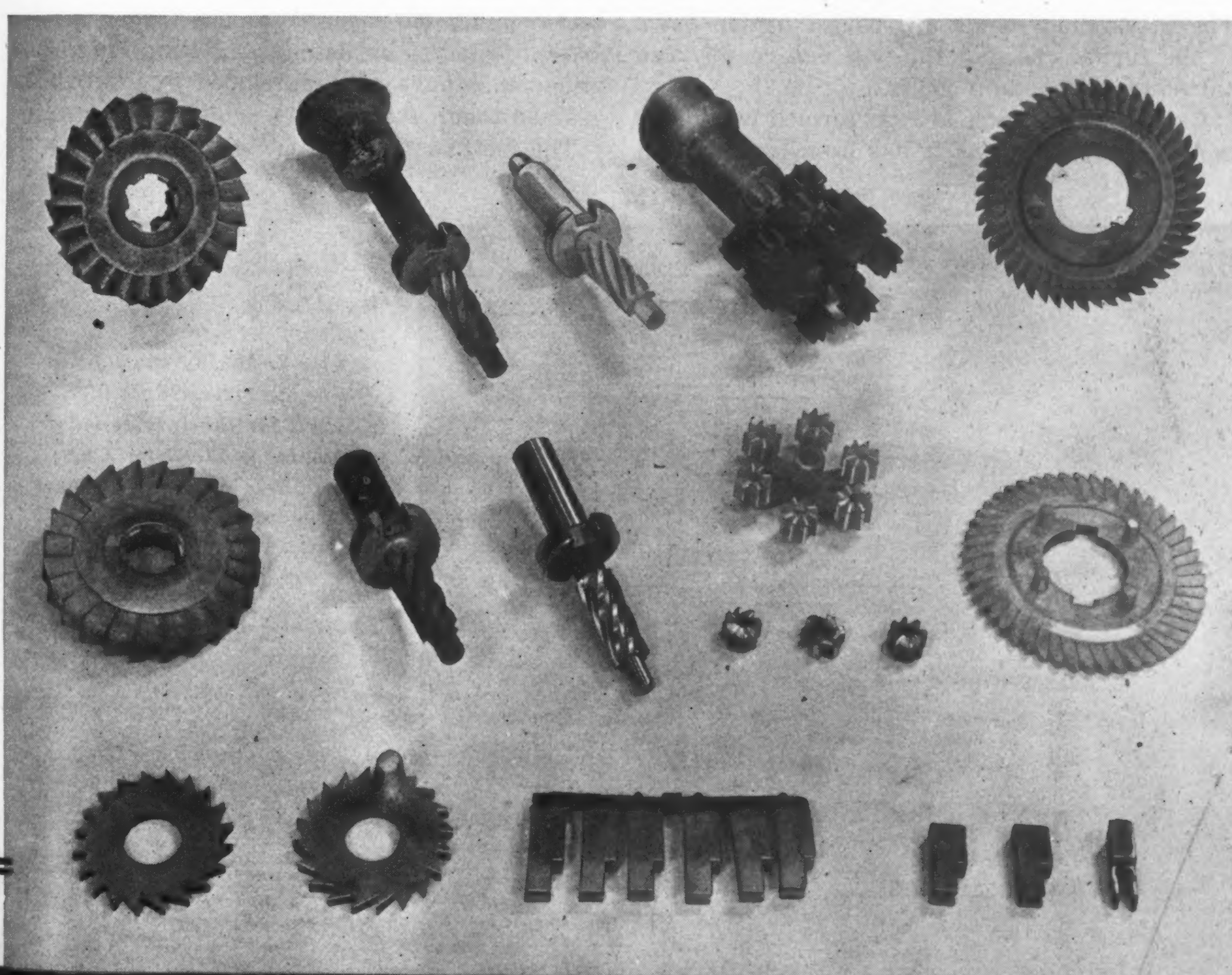
Fig. 5. Risers are Attached to the Wax Patterns, and Some Wax Patterns are Built up in Multiple by Merely Melting Bosses on the Parts to be Joined and Holding the Parts together until the Melted Wax has Solidified

piece of plywood, ready for building up the investment mold.

The next step in precision casting is to mount a conical mask of sheet steel on the board to which the wax pattern has been attached and to fit a lining of asbestos paper around the inside of the mask. This completes a flask assembly. Such an assembly is seen at the right in Fig. 7.

For the investment mold it is important to use a refractory material that is not subject to thermal expansion to the extent that silica is. Ford practice is to use such materials as alu-

Fig. 6. Variety of Wax Patterns, together with Precision Castings as They Come from the Mold and as Sharpened Ready for Use



minum oxide, magnesium oxide, and zirconia. The mold material is mixed with a chemical setting binder that acts like cement or plaster-of-paris to shape the mold closely around all details of the wax pattern. The correct proportions of the mixture have been determined by experimentation and are accurately observed. In Fig. 7, one of the veterans is seen preparing such a mixture.

The mixture is made fairly thick, but sufficiently liquid to be poured from a large cup, and the mask is filled right to the top. The mixture is poured gradually while the flask is being shaken on the vibrating machine, this step of the process being illustrated in Fig. 8. Shaking the mold insures the release of all air bubbles in the mixture and the production of a smooth mold surface all around the wax pattern. These investment molds are allowed to stand for approximately twenty-four hours after pouring, in order to insure complete solidification before any cutters are cast.

When the molds have solidified, they are placed in the electrically heated oven seen in Fig. 9 for melting, vaporizing, and burning up the wax patterns. Furnace temperatures up to 1200 degrees F. are used; a temperature of 150 to 160 degrees F. is employed for melting the wax, and higher temperatures for dissipating the wax. The investment molds are placed upside down in the furnace so that the wax can readily run out of the molds as it melts.

Casting operations are performed while the molds are still hot, as it has been learned that cutters can be more readily cast with clean sharp edges and smooth surfaces when a mold is hot than when it is of room temperature.

The metal from which the cutters are to be cast is melted in the small carbon-arc electric furnace seen in the heading illustration, which has a capacity for a 15-pound charge. Power is supplied to this furnace from a 220-volt circuit through a 15-KVA transformer. A series of taps from the secondary permits selection of voltages to suit the specific job.

This furnace is charged with bars of steel having an analysis corresponding to that desired in the cutters being cast. The bars have been previously cast from melted scrapped reamers, taps, milling cutters, and so on, but virgin metal could be used as well. Before a melt is poured, a spectrographic analysis is made of a specimen cast from the mixture in order to make certain that the composition meets specifications. Melting temperatures range up to 4000 degrees F. Optical pyrometers are employed to check the temperature of the melt.

Pouring takes place with one man holding the investment mold in front of the furnace by means of tongs and a second man tilting the furnace, in the manner seen in the heading illustration. When the casting has solidified, the investment mold is broken up and the casting is cooled under close control. The larger cutters are subjected to hardening and tempering operations that have been developed to insure fine-grained tough structures.

The final castings are, of course, intact, with

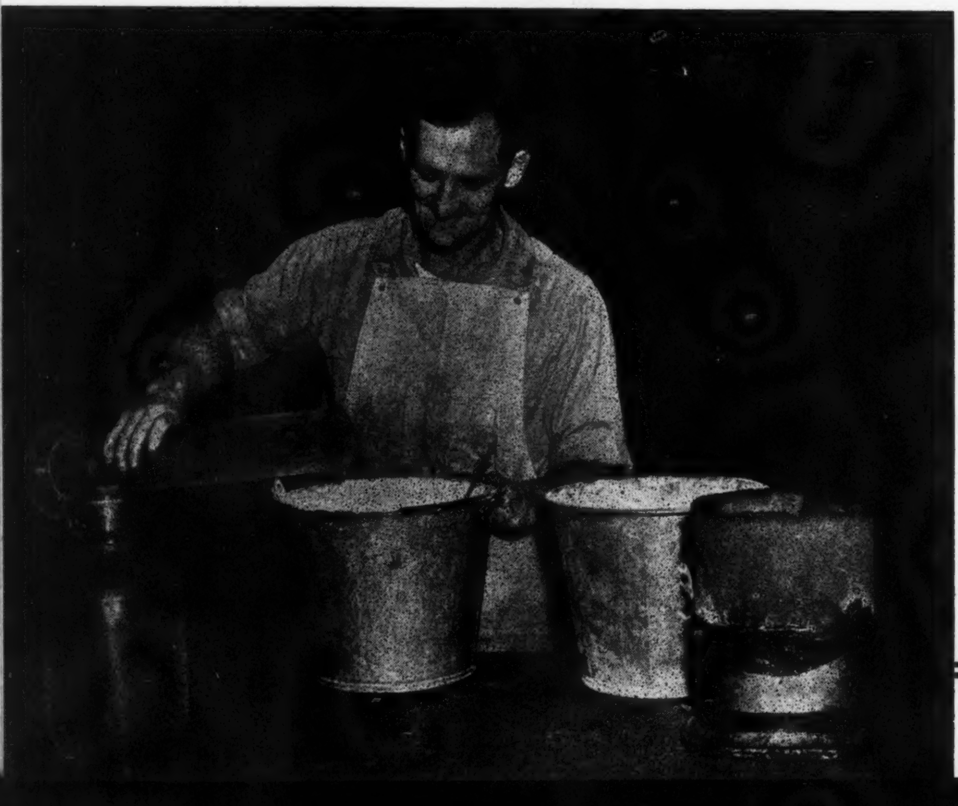


Fig. 7. Mixing the Powder and Liquid Binder Used for the Investment Molds. A Flask for One of These Molds is Seen at the Right

BY PRECISION CASTING

integral gates or risers, as seen in Fig. 1. These are readily removed by abrasive saws, after which the cutters are sand-blasted for the sake of appearance, and finally, the cutting edges are sharpened on standard tool and cutter grinders. No other machining is necessary.

In addition to cutters of the types shown, bits for lathe tools have been produced in the form of rods by precision casting. These rods are cut up to suit requirements. In the center of Fig. 1 is seen a casting that embodies eighteen small spot-facers.

Large savings in money have been effected by this process. More than 10,000 cutters have already been made by the method outlined—over 5000 small spot-facers alone. Hundreds of tests on precision-cast cutters show that their service life compares favorably with that of high-speed steel cutters made in the usual way.

While this article deals entirely with the application of precision casting to the production of high-speed steel cutters, the process has much wider possibilities in an automotive plant. For example, automobile parts of medium size that must be made to accurate dimensions could undoubtedly be precision cast with all grinding or other machining eliminated. Plastic molds with duplicate cavities could be produced inexpensively by precision casting the cavities and applying them to the mold in the form of inserts, thus eliminating tedious die shaping and engraving operations. Undoubtedly many more applications will become apparent when post-war production is resumed on a large scale.

Fig. 8. The Investment Mold Mixture is Poured into the Flask while the Latter is Vibrated on a Machine to Insure the Release of Air Bubbles in the Mixture

Fig. 9. The Investment Molds are Placed in an Electrically Heated Oven for Melting and Burning away the Wax Patterns. This Step in the Precision Casting Process Leaves Molds without Any Parting Lines

Powdered Metal Points the Way

The Art of Compressing and Sintering Metal Powders into Bearings and Machine Parts has been Developed to Such an Extent that Products Weighing as Much as 100 Pounds can be Economically Made by This Process

By A. J. LANGHAMMER, President
Amplex Division, Chrysler Corporation, Detroit, Mich.

WARTIME necessities have presented an exceptional opportunity for the proponents of powder metallurgy to prove the far-reaching possibilities of this art to a hitherto somewhat skeptical metal-working industry. In the war emergency it has become imperative to build up the fighting power of the United Nations in a minimum time, and to achieve that end, new manufacturing processes have been developed, and others that were being adopted slowly in pre-war days have suddenly attained proper recognition. Powder metallurgy as applied to the production of machine parts is in the latter category.

One of the outstanding wartime achievements of powder metallurgy has been a tremendous

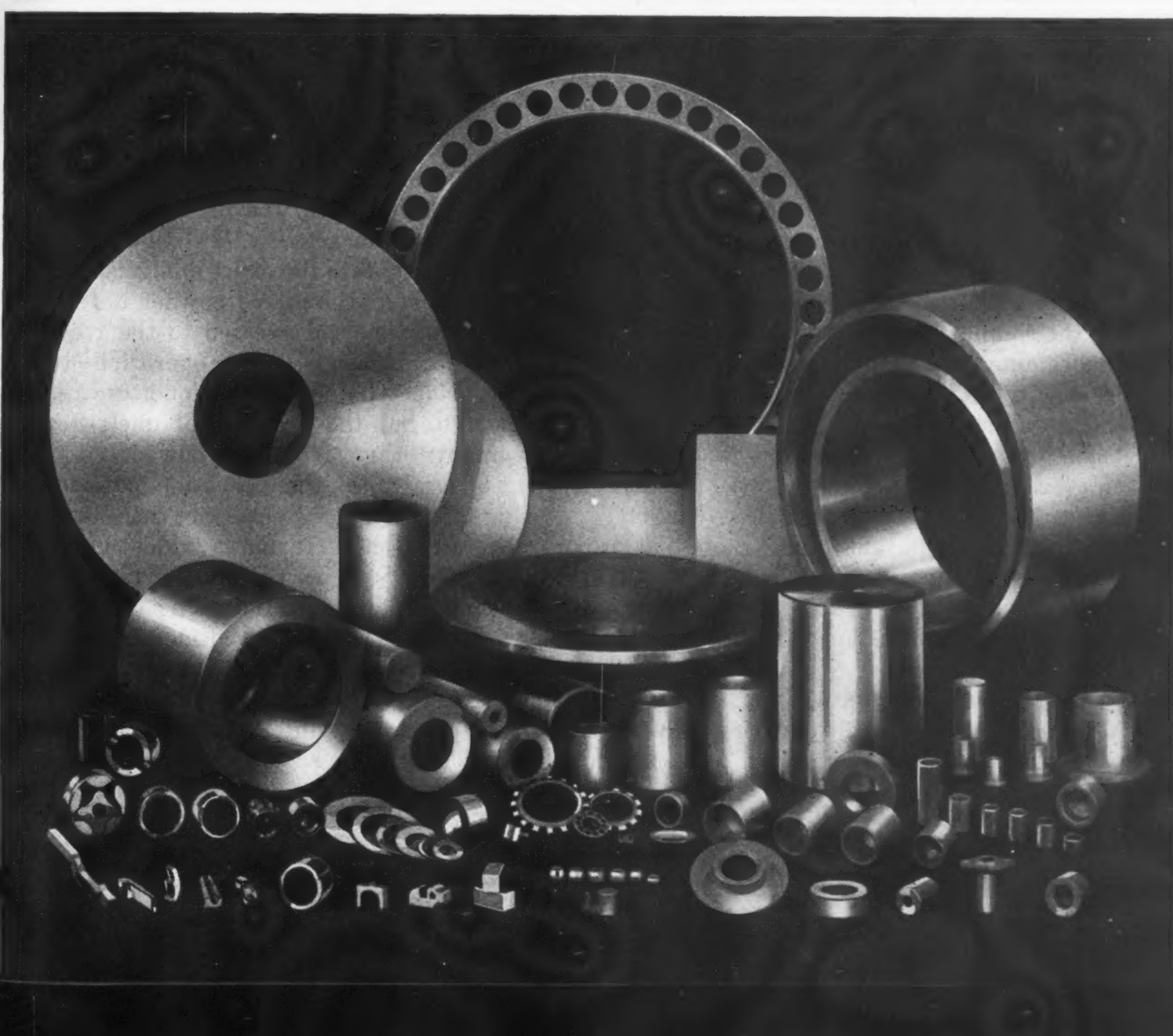
to Machine-Building Economies

saving of time and material in the manufacture of detail parts for Bofors guns. One hundred and six Oilite bearings and parts for these guns are each made from powder in a matter of seconds, instead of minutes and, in some cases, hours. During a twelve-month period, more than 5,000,000 man-hours and 1,250,000 pounds of critical metals were saved in making these gun parts from powdered metal. Taking one of these gun parts as an example, approximately two hours was required to machine the piece when it was a forging. Now it is being made from powder in twenty-two seconds, not including the heat-treatment. The powdered-metal part requires no machining, except for drilling a small hole. Another remarkable wartime record of powder metallurgy has been the production of over 5,000,000 rotating bands for 38- and 40-millimeter shells.

Until two or three years ago, the largest products of powder metallurgy were approximately 4 inches in diameter and had a weight ranging from 2 to 3 pounds. Very small pieces were the customary products, and the great majority of pieces were made from non-ferrous powders. During the war period, great advances have been made in the production of iron and steel parts from metal powders, and parts weighing as much as 96 pounds are being regularly produced.

This article will deal primarily with powdered metal as applied in making machine parts of

Fig. 1. Large Selection of Bearings and Other Machine Parts Made from Powdered Metal at the Amplex Division of the Chrysler Corporation. Some of These Parts are Made 200 Times Faster than would be Possible by Other Manufacturing Methods



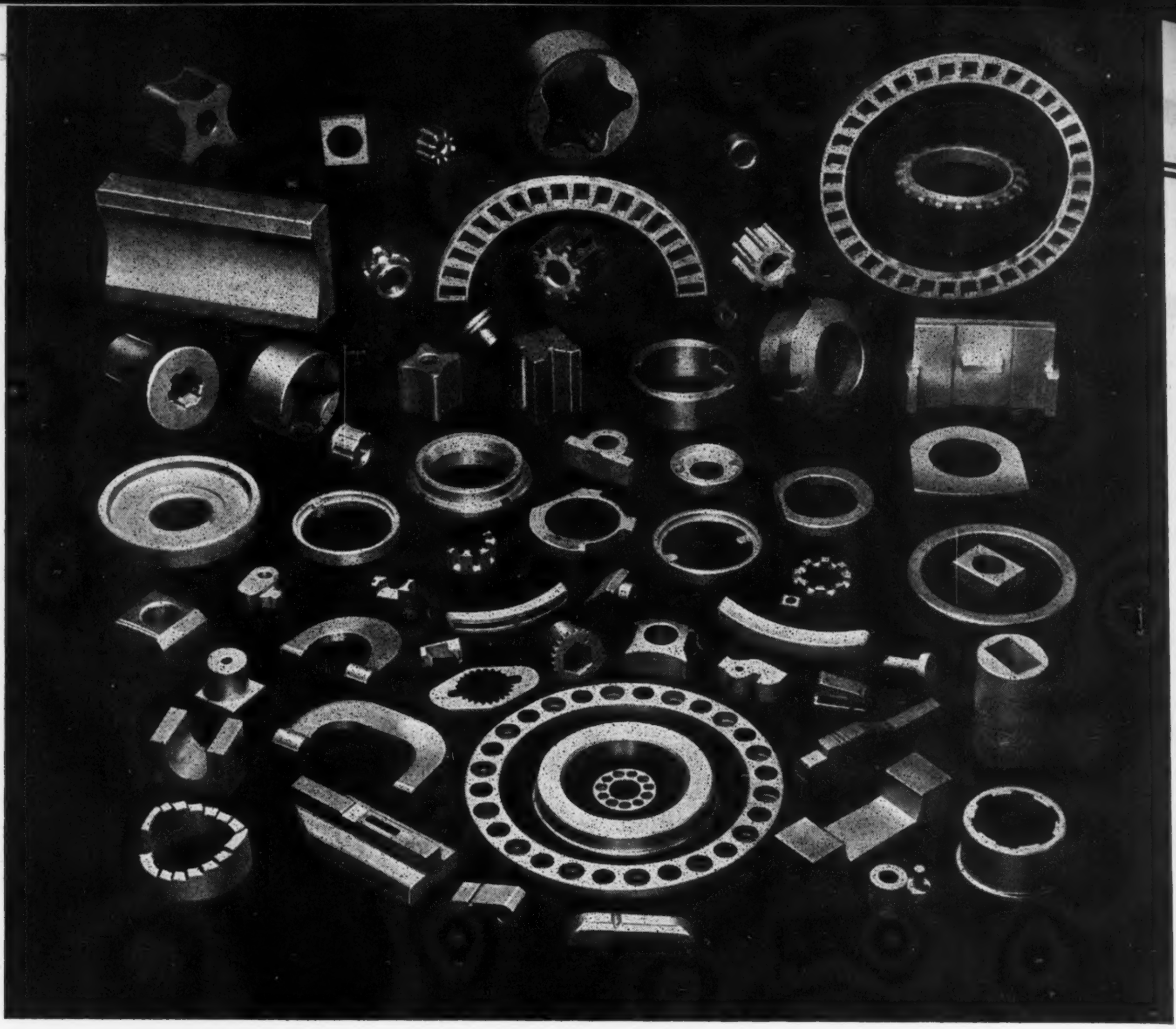


Fig. 2. Another Group of Powdered-metal Machine Parts. Some are of Porous Structure and Others Dense; Some are Self-lubricating and Others Dry. Very Few Require Machining Operations to Prepare Them for Use

various types at Chrysler Corporation's Amplex Division. The products include self-lubricating bearings, precision V-blocks, pump gears, height gage bases, micrometer frames, ball-bearing separators, and so on. It should be pointed out, however, that the ramifications of powder metallurgy are far more extensive than this. For instance, all wire, electrodes, and electrical contacts of tungsten, tantalum, and other tough refractory metals are produced from powders that have been compressed and sintered. Powder metallurgy has also made possible our fast cutting tungsten-, titanium-, and tantalum-carbide tools. It was for drawing tungsten wire, which makes possible modern fluorescent and incandescent lighting, that powder metallurgy was first applied in the United States.

There are four major steps in transforming an unpretentious pile of metal powder, such as seen in the heading illustration on the platen of a hydraulic press, into strong and accurate parts. The first step in the process consists of mixing the pure metal powders (one of which is a binder), to obtain the exact analysis desired. In the second step, the mixed powder is fed into dies of presses and compressed to the required shape and dimensions, this operation being termed "briquetting." The briquettes appear solid enough, but the pressure of one's fingers will transform them back into powder.

The third step in the operation consists of sintering the briquettes by passing them through controlled-atmosphere furnaces which are operated at temperatures up to 2100 degrees F. In this heating process, the binder (metal of low melting point) of the powdered metal melts and combines the metal particles together to form a strong cellular structure. Sintering takes a minimum of thirty minutes. In the fourth step, the sintered parts are sized in the dies of power

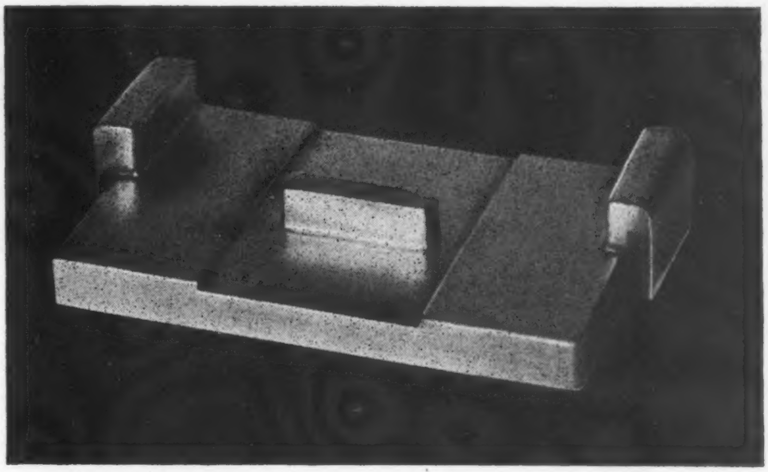


Fig. 3. A Bronze Part that Comes from the Sizing Press Ready for Use without Any Subsequent Machining. Hours of Tool-room Work were Required when This Part was Made by Standard Practice

presses, in order to insure products that meet specified dimension tolerances.

There is an important fifth step in manufacturing Oilite self-lubricating bearings and some other parts. This consists of impregnating the parts with a non-gumming lubricating oil, thus insuring copious self-lubrication that often lasts for the lifetime of the part.

The principle of the briquetting operation is clearly illustrated by diagrams X and Y in Fig. 7, which shows a mechanically operated press equipped with dies for the production of a plain cylindrical bearing. It will be seen that there is an upper punch A and a bottom punch B, the press being designed with upper and lower rams for single- or double-end compression. Diagram X shows the punches at the beginning of an operation with the briquetting die C loaded from the top of the bottom punch to the die face with metal powder, as indicated at P. A core rod D extends from the bottom ram to the top of the die for forming a hole in the work-piece. At E is seen a loading shoe which swivels across the face of the die to discharge the metal powder into the die in the exact amount required for making the part.

In the briquetting operation, the upper punch first descends to the face of the die, and then the upper and lower punch are moved simultaneously toward each other at the same rate of speed, so as to cause equal compression of the powder from the top and bottom. This insures a part of approximately uniform physical properties throughout. If a top punch only were employed, obviously the powder at the bottom of the die would not be compressed with as great pressure as the powder at the top of the die which actually came into contact with the moving punch.

When the briquette has been made and the top punch withdrawn, the lower punch moves upward an additional amount to eject the briquette from the die. Diagram Y shows the punches and die after the upper punch has been withdrawn and before the lower punch starts the ejection stroke. The briquette is seen at W.

The pressure applied in briquetting depends upon the total area and the shape of the work-

Fig. 4. Four Machine Parts of a Type that would Require a Great Deal of Machine Work if Produced by Ordinary Methods, which are Made from Metal Powder in a Few Seconds

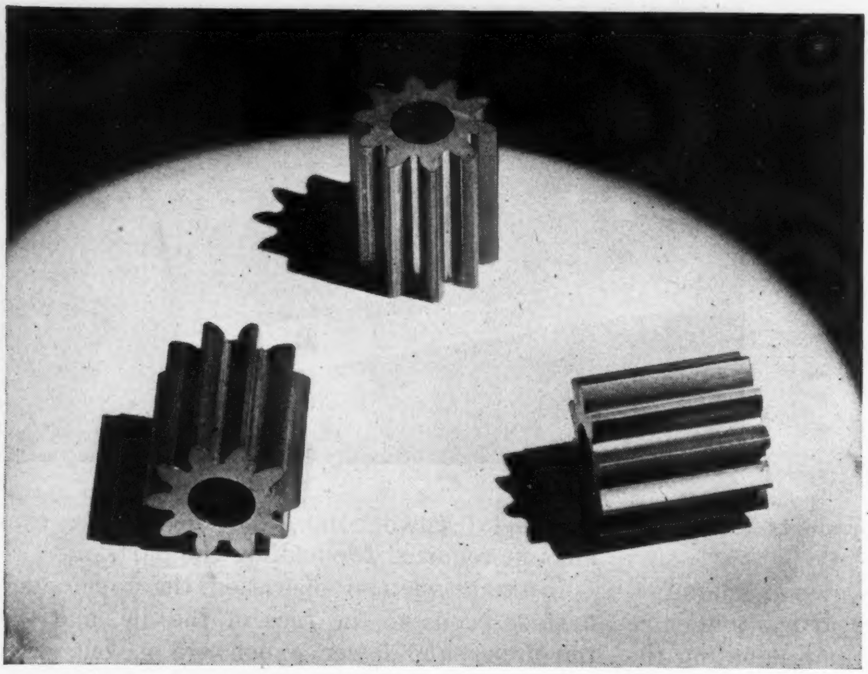


Fig. 5. Gears for Non-Power-transmitting Applications can be Satisfactorily Produced by Powder Metallurgy with Teeth as Small as 1/16 Inch in Width

pieces; upon the metals from which they are made—that is, bronze, brass, aluminum, or iron; and also upon the type of structure desired in the finished part—that is, whether it is to be porous or fairly dense. The minimum pressure employed at Amplex is about 15,000 pounds per square inch, while the maximum pressure is probably around 100,000 pounds per square inch. Each briquette weighs exactly the same as the charge of powdered metal, since there is no waste of material.

The diagram in Fig. 8 shows the type of die that would be provided for sizing plain cylindrical bearings, such as produced by the briquetting set-up in Fig. 7. The upper punch *A* has a long cylindrical extension which fits into the hole of the work-piece to insure correct internal and external diameters. It is the practice in sizing to compress the work-piece several thousandths of an inch. For example, on bearings 2 1/2 inches in diameter, the sizing would reduce the external diameter from 0.008 to 0.010 inch and increase the inside diameter about the same amount. The lower ram of sizing presses is equipped merely with a knock-out *B*, which raises the sized work-piece *W* above the face of

Physical Properties of Oilite Powdered-

Physical Properties	Heavy-Duty, Oil-Cushion Bearings and Machine Parts		
	Oilite Bronze	Super-Oilite	Iron Oilite
Ultimate Tensile Strength (Pounds per Square Inch)	12,500	30,000	15,000
Compression Permanent Deformation			
Pounds per Square Inch for 0.001 Inch Set	11,000	30,000	22,000
Pounds per Square Inch for 0.005 Inch Set	16,000	47,000	40,000
Pounds per Square Inch for 0.015 Inch Set	18,000	58,000	60,000
Elongation in 2 Inches, Per Cent, Minimum	5	1	1
Brinell Hardness	30	45	40
Porosity (Oil by Volume—Per Cent)	30	25	30
Specific Gravity	6.0	6.0	5.8
Weight per Cubic Inch in Pounds	0.22	0.23	0.22
Coefficient of Thermal Expansion per Degree F.	10.5×10^{-6}	7.7×10^{-6}	6×10^{-6}
Electrical Conductivity (Per Cent of Copper)	7.68	10.8	8.3

Fig. 6. Parts Produced from Metal Powder Can be Made so Porous that They can be Used for Filtering, Venting, Mixing, Separating, Metering, Diffusing, Flame-arresting, and Similar Applications

the die for easy removal. Parts sized with such equipment have smooth, shining surfaces, and are generally ready for assembly operations without further machining.

Machine parts are made by the Amplex Division in three classifications—Oilite, Stressite, and Damascite. Oilite includes parts made from bronze, iron, and aluminum powder, and products so termed are intended for use where self-lubricating properties are important and porosity is a necessity. Stressite parts are made from the same metal powders for applications where self-lubrication is of less importance, but where the parts must possess higher physical properties. Damascite is a steel, and parts of this classification do not possess the self-lubricating feature. The hardness of Damascite parts ranges up to 65 Rockwell C.

The accompanying table gives the physical properties of Oilite, Stressite, and Oilite "16" parts intended for heavy-, advanced-, severe-, and extreme-duty applications. The properties of Damascite parts are not given in this table, as they can be varied widely to meet the requirements. Damascite parts can be made soft and ductile or like hardened tool steel.

It will be obvious from Figs. 1 and 2 that powder metallurgy can be applied for manufacturing a wide variety of parts. Generally speaking, the easiest parts to produce are those that have a symmetrical outline, whether it be truly cylindrical or changing uniformly in contour, as

Metal Parts for Various Classes of Duty

Advanced-Duty Oilite Machine Parts			Severe-Duty Stressite Machine Parts			Extreme-Duty Bearings and Machine Parts
Oilite Bronze	Super-Oilite	Iron Oilite	Oilite Bronze	Super-Oilite	Iron Oilite	Super-Oilite "16"
18,000	35,000	30,000	40,000	45,000	35,000	40,000
20,000	35,000	30,000	30,000	40,000	35,000	70,000
25,000	60,000	50,000	35,000	70,000	55,000	90,000
40,000	75,000	70,000	......	.....	......	120,000
10	2	2	20	2	2	140
40	60	70	60	90	90	......
......	......	......	......	.....	......	5.8 to 6.2
6.9	6.8	6.2	0.30	0.256	0.24	430
0.25	0.25	0.230	8.3	7.0	6.6	0.25
10.5×10^{-6}	7.9×10^{-6}	6.8×10^{-6}	10.8×10^{-6}	8×10^{-6}	7.0×10^{-6}	8×10^{-6}
6.73	12.05	11.1	17.4	11.8	......	1

in the case of gears. However, the process can also be employed advantageously for forming odd-shaped parts such as may be seen in Fig. 2. Flat strips can be produced with ease in thicknesses as small as 1/32 inch and in lengths up to approximately 24 inches. Many of the parts in these illustrations are made of iron powder, with which metal there have been especially wide developments in the last two years.

There is, however, one important limitation to be remembered by the designer of parts produced from powdered metal. Because of the fact that briquettes are made by opposing pressures applied vertically only, no part can be made that would require sidewise movement in the die members for the formation of pockets, etc. It should also be well understood that metal powders cannot be made to flow satisfactorily around die corners. All powder movement, therefore, must be in line with the directions in which the punches of the briquetting press operate. Threads cannot be formed by powder metallurgy, because that would necessitate a split die that could be opened sidewise. All briquetting dies are made in one piece.

Cored openings can, of course, be made in the vertical direction, as shown by a number of examples in Fig. 2. Corners can be formed on briquettes as sharp as good design would dictate. It should be noted that parts requiring subsequent machining operations also offer advantages and economies when made from powdered metals. Parts impossible to make by standard methods often can be produced by powder metallurgy. Such units include a spline to the flange face, a hexagonal recess in the face of a part, and the like.

Near the top center of Fig. 2 is seen a tool-

Fig. 7. (Left) Diagrams Illustrating the Operation of Briquetting Presses which Transform Powder into Metal Parts in from Two to Six Seconds. Fig. 8. (Right) Cross-section of a Typical Punch and Die Employed in Sizing the Sintered Powdered-metal Products.

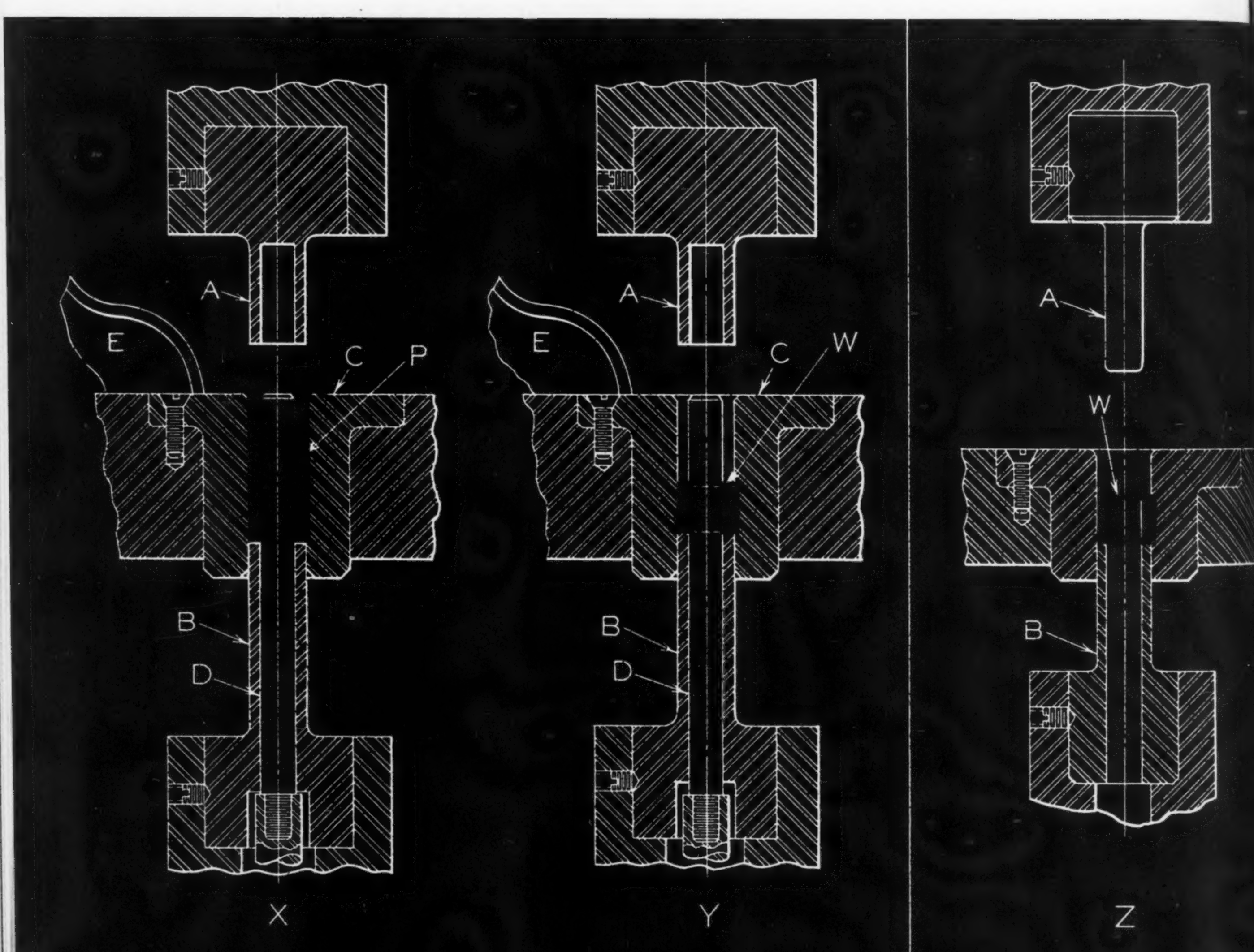


Fig. 9. Simple Briquetting Operation in which Powdered Metal is Fed into the Die by Hand

makers' V-block of steel, which was turned out in large quantities to meet urgent demands during the war period. These V-blocks are file-hard. Micrometer frames are shown near the lower left-hand corner of the illustration. Near the bottom center, just to the upper left of the large ball-bearing retainer, are two mating parts with internal and external V-shaped ratchet teeth. Of particular interest is the fact that the part having the external teeth has a hole that is eccentric in relation to the hub and a hexagonal countersink at the face. It would be practically impossible to produce a part of this kind by machining methods, whereas by briquetting, it can be made in a matter of seconds only.

Another part of unusual interest is seen at the extreme left end of the bottom row in Fig. 1. This is a small finger of a type used in large quantities on textile machinery. One end rides on a shaft and must be self-lubricating, while the opposite end operates some other machine member and must be hardened in order to resist wear. Thus, in processing, one end of this finger is left fairly soft and porous, so that it may be oil-impregnated, while the other end of the finger is hardened.

Fig. 3 shows a bronze part that is used just as it comes from the sizing press. To machine such a piece would require hours in the toolroom. At the left in Fig. 4 are seen special gears

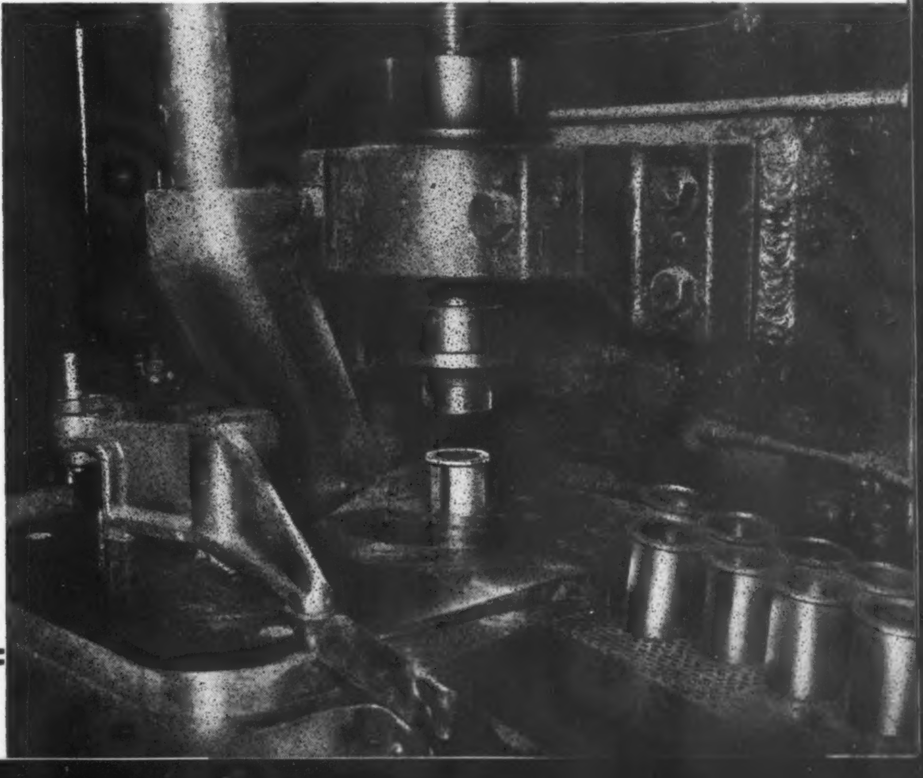
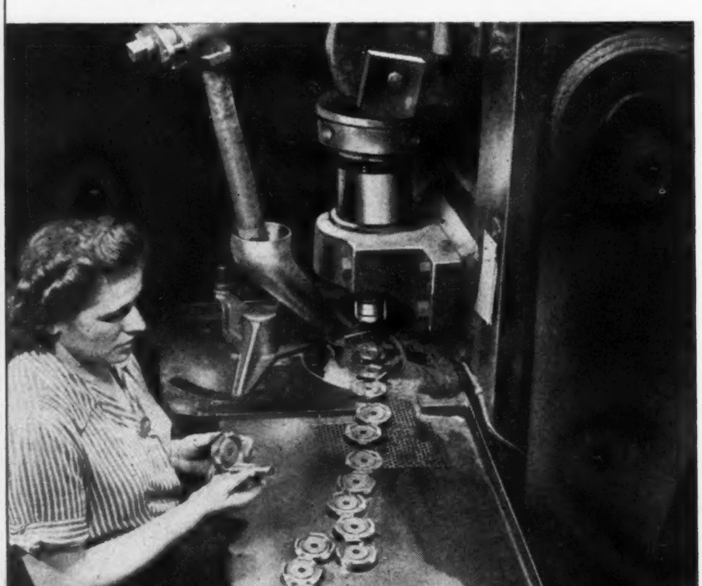


Fig. 10. Briquetting Operation in which the Press is Equipped with an Automatic Powder-loading Shoe. The Briquette is being Automatically Ejected from the Die

Fig. 11. Operation in which Iron Powder is being Transformed into Briquettes of Special Four-tooth Impeller Gears which will be Placed in Use without Any Machining Operations

Fig. 12. Employing Powder Metallurgy for the Rapid Manufacture of a Part that would Present Difficult Machining Problems if Produced by Standard Practice



for a bilge pump, which are made from bronze. Each of these parts is briquetted at the rate of one piece every nine seconds, ready for use after sintering and sizing without the need for any machining. When the parts were machined, the production time was about four minutes per gear. At the right in this illustration is shown another Damascite part which presented some difficulties because of the appreciable difference in height between some of the surfaces.

It has been stressed in this article that it is possible to form metal parts so that they are sufficiently porous to permit oil impregnation for self-lubricating purposes. However, the metal parts can be made so porous by briquetting and sintering that the parts can be used for filtering, venting, mixing, separating, metering, diffusing, and so on. Fig. 6 shows a variety of parts made from bronze powder for such applications. Parts of this classification may be approximately 50 per cent porous. In making filters, the powder particles range from about 0.008 to 0.010 inch in size, whereas for machine parts the powder particles are as fine as 0.001 to 0.002 inch.

There is no difficulty in making spur gears (oil-pump type) by this process, as the teeth are located symmetrically around a center. Teeth as small as 1/16 inch in width can be produced successfully. The limitation so far as gears are concerned is strength. It is possible to produce gears with a tensile strength as great as 50,000 pounds per square inch, but that, of course, is not sufficient for operations under stresses such as are generally encountered in an automotive transmission. Pump gears made from iron powder are illustrated in Fig. 5. These gears are briquetted at the rate of eight seconds per part.

The remaining illustrations in this article show operations involved in the transformation of powder into machine parts ready for use. Fig. 9, for example, shows a set-up on a hand-fed machine which produces plain Oilite bearings, about 2 3/4 inches outside diameter by 2 inches long. In Fig. 10 is shown an automatically fed machine which turns out flanged bearings at the rate of one every six seconds. The loading shoe that automatically delivers the metal powder to the die, and the pipe that brings the powder to the shoe from an overhead hopper, are seen at the left.

Fig. 11 shows the set-up employed in pro-

ducing the special four-tooth bilge-pump gear shown in detail in Fig. 4, while Fig. 12 shows an operation in which the parts being briquetted at high speed are of a design that could be machined only with considerable difficulty.

It has been mentioned that sintering is performed immediately after briquetting. One of the furnaces employed for the sintering operation is illustrated in Fig. 13, which shows the loading end. The parts are carried through the furnace on a wide-mesh conveyor, the speed of which can be regulated to suit the particular type of parts being handled. These furnaces are approximately 50 feet in length, and the period of sintering varies from thirty up to fifty-two minutes, including a cooling period. Some parts are oil-impregnated immediately after this operation. Most parts, however, are first run through sizing presses and then dipped in hot oil while contained in metal baskets, in the manner illustrated in Fig. 14.

Fig. 13. Loading End of One of the Controlled-atmosphere Furnaces that are Employed for Sintering the Powdered-metal Briquettes

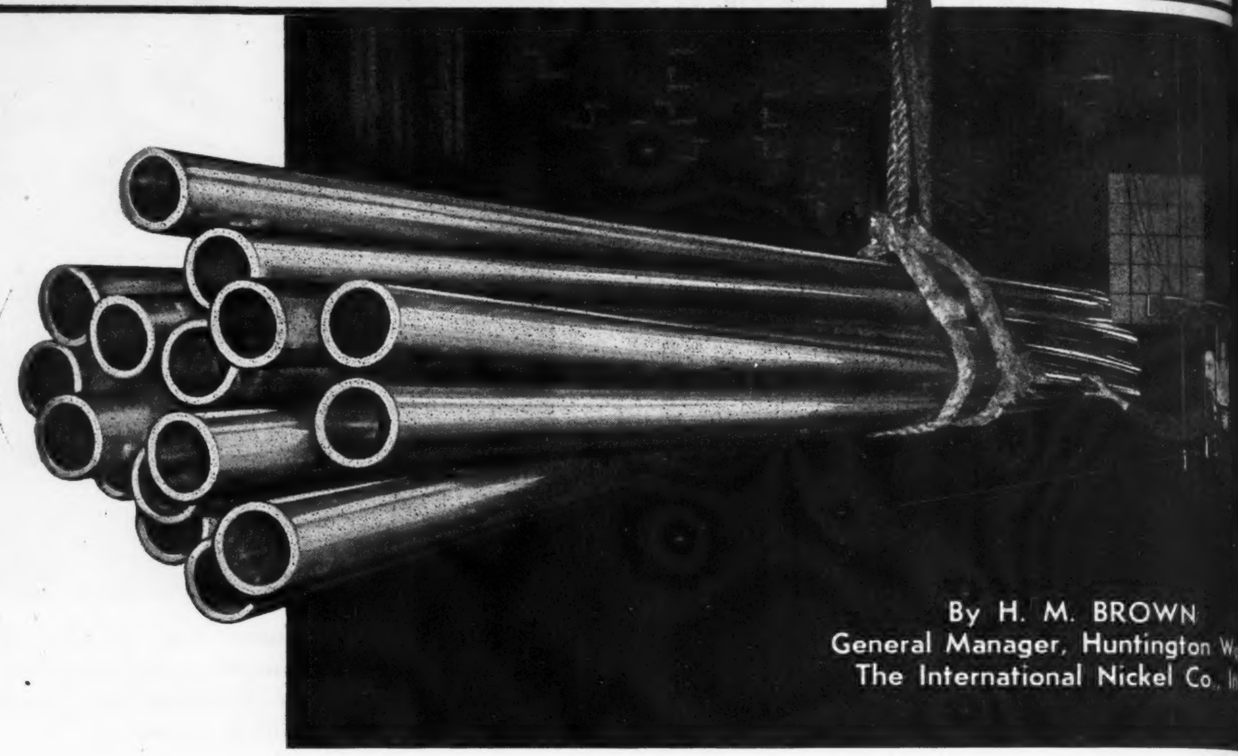
Fig. 14. After a Sizing Operation in a Power Press, Sintered Powdered-metal Parts that are to be Self-lubricating are Dipped in Hot Oil Baths to Impregnate Them with Oil

Collecting Steel Chips in the Pontiac Plant

The Pontiac Motor Division of General Motors Corporation has installed automatic chip disposal means in one of its shell plants where four tons of steel turnings accumulate every hour. The chips or turnings from shell forgings are chiefly in the form of continuous curled strips. Because of their bulkiness and spring-like properties, they are extremely difficult to handle and wasteful of shipping space. These difficulties, however, are overcome by an automatic system which requires the services of only two men to handle four tons of steel turnings an hour.

Between the rows of the turning machines troughs are installed several feet below the floor into which the chips drop directly from the machines. They are washed along by the cooling fluid from the machines, which is also discharged into the trough. An elevated conveyor ultimately drops the turnings into a chopper, which breaks them up into small chips. Another conveyor then carries these chips to the top of a loader from which they fall directly into freight cars from the loader's movable spout.

Extrusion of Nickel Alloys



By H. M. BROWN
General Manager, Huntington W
The International Nickel Co., In

The Technique Employed in Extruding Large Tubes in a 4000-Ton Hydraulic Press by a Process that Reduces Scrap Loss to a Minimum

IN past years when it was found desirable to make extrusions of nickel, Monel, Inconel, and other high-nickel alloys, it was necessary to ship billets of these metals to one of several European plants, because there was no extrusion equipment in the United States capable of handling these alloys. This manufacturing handicap—with its months of delay—has been eliminated by the recent installation of a 4000-ton horizontal hydraulic press in the Huntington, W. Va., Works of the International Nickel Co. This machine, the largest of its type in the world, had been engaged in turning out large quantities of critical war material. Its wartime service points toward wide peacetime production possibilities for this equipment.

This press was designed by Hydropress, Inc., 570 Lexington Ave., New York City, primarily for extruding nickel products in the plant mentioned. However, with the increased demand for heavy artillery shells, the War Department found it necessary to increase the output of rotating bands. It was proposed that the new press in this International Nickel plant be used for extruding 8-inch tubes from gilding metal (90 per cent copper, 10 per cent zinc) to be cut into short lengths for use as rotating bands. As a result, the press is being used at present for this work, extruding gilding metal tubes to an inside diameter of 7.945 inches and an outside diameter of 8.900 inches in 10-foot lengths. The practice proved so satisfactory that a smaller 2750-ton press has been installed in the same plant to turn out tubing that is cut into rotating bands for 155-millimeter shells.

The production of shell-band tubing will be described in this article, although, as already mentioned, the press will eventually be used

Now Possible in This Country

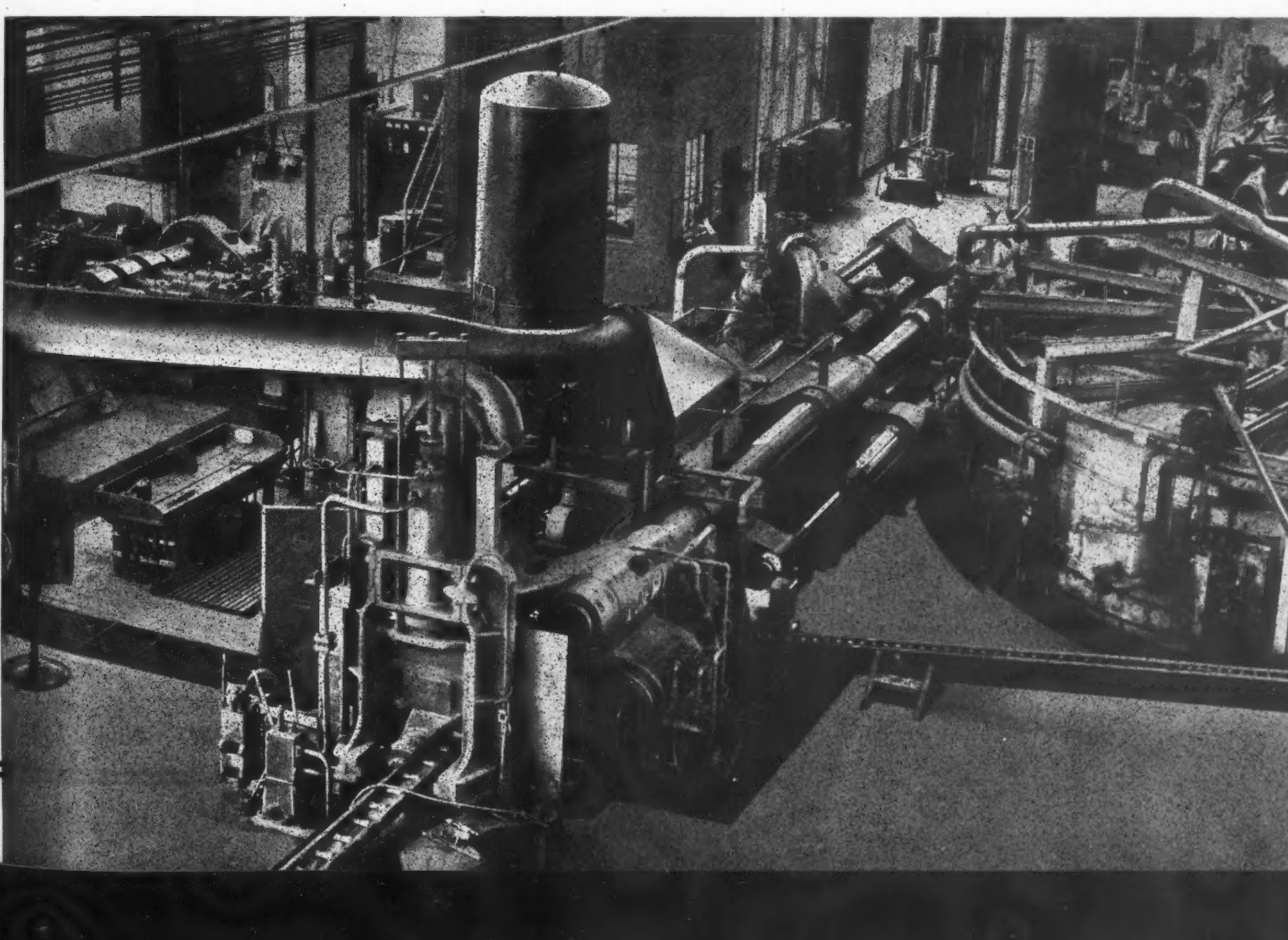
entirely on nickel products, and considerable quantities of extruded tubes from nickel and high-nickel alloys have already been produced. Whether copper or nickel alloys are being handled, the general principles of operation of these extrusion presses are the same. There are, however, differences in the extruding tools, as will be outlined in this description.

The raw material for the rotating shell bands comes to the extrusion department in the form of billets 11 7/8 inches in diameter by 18 inches in length, weighing an average of 600 pounds. These billets are heated in the rotary-hearth, natural gas-fired furnace seen at the right in Fig. 1. There are forty-three stations around the hearth in which V-blocks are provided to prevent the billets from shifting as the hearth rotates. The billets are conveniently loaded into the furnace and removed at the end of the heating period by long tongs attached to trolleys that run on overhead beams in line with the loading and unloading doors, as seen in Fig. 3. The billets are placed on their sides in the V-blocks.

Each billet remains in the furnace for three hours, at the end of which time it has attained a temperature of approximately 1670 degrees F. The furnace is operated with a reducing atmosphere. In the case of nickel-alloy billets, higher temperatures are necessary—up to 2200 degrees F. for some special alloys. The heating period for nickel alloys is generally about the same as for gilding metal, although the time can be conveniently varied by means of an automatic control clock. In addition to nickel, Monel, and Inconel, gilding metal and copper tubes have been produced.

When the billets have been heated in the rotary furnace to the required temperature and

Fig. 1. 4000-ton Extrusion Press which Now Makes Possible the Extrusion of Nickel Alloys in This Country. This Press is also Employed for Extruding Large-diameter Tubes from Gilding Metal, which are Cut up into Rotating Bands for 8-inch Shells



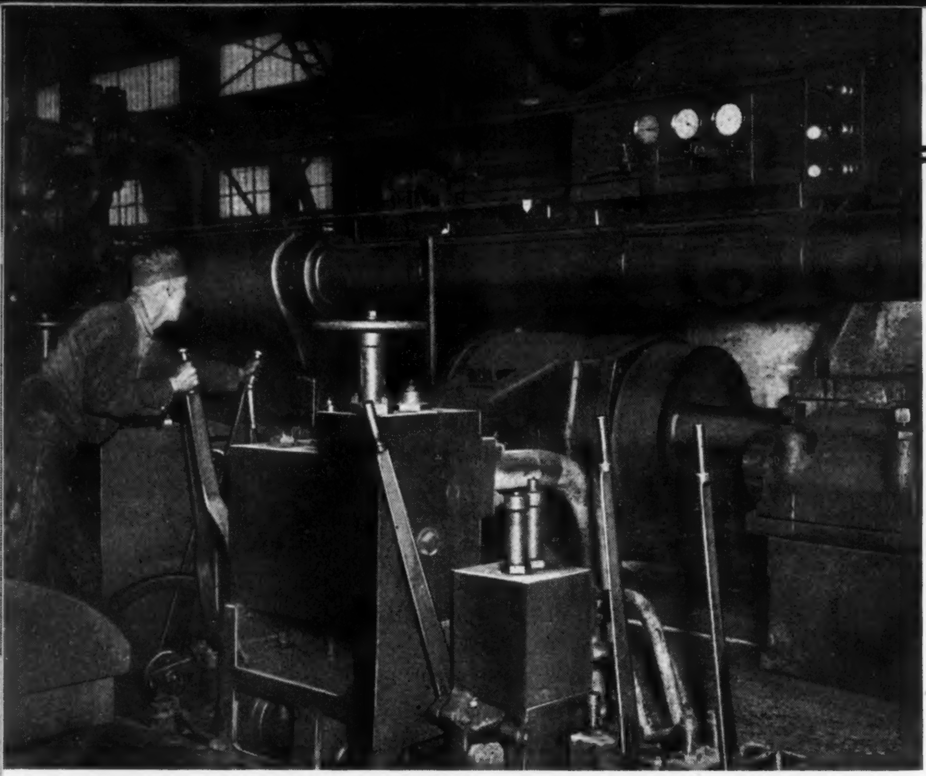


Fig. 2. Operator's Platform from which Various Hydraulic Movements of the Extrusion Press are Controlled

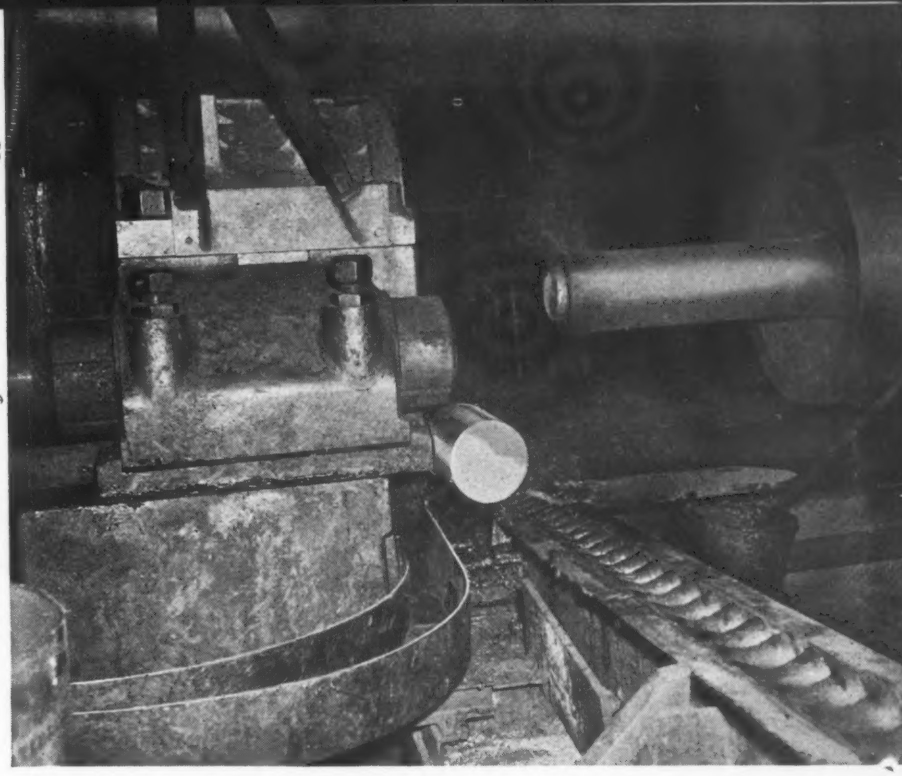
reach the unloading station, they are removed by another pair of tongs and placed on a gravity roller conveyor which leads to the extrusion press container, as shown in Fig. 4. When it reaches this point, the billet slides from the conveyor onto a hydraulically operated elevator which raises it to the center line of the press, as seen in Fig. 5.

While being raised, the elevator platform swings through 90 degrees, so as to bring the lengthwise center line of the billet into direct line with the press stem and also with the container. The container consists of three parts, the inner one being a cylindrical liner of heat-resisting steel, as indicated at *A*, Fig. 6. The elevator is controlled from the operator's station at the front of the machine where, as seen in Fig. 2, there is a series of levers for actuating the valves of various hydraulic units that control the machine movements.

In the next step of the operation, while a closing plate is interposed between the container and the extrusion die, the billet is pushed into the container by the advancing stem *C*, Fig. 6, mandrel *B*, and dummy ring *D*. The dummy ring is placed over the mandrel prior to this step. It can be seen in place on the mandrel in Figs. 4 and 5. The closing plate is seen at *E*, Fig. 6. It is carried by a vertical slide shown in Fig. 11. Silent chains operate the slide.

Fig. 3. Placing a Billet of Metal to be Extruded in a Rotary-hearth Furnace which Heats the Billets to Extruding Temperature

Fig. 4. From the Rotary-hearth Furnace, the Heated Billets Slide down a Gravity Conveyor to the Extrusion Press



The hydraulically actuated stem *C* and mandrel *B* then advance to push the billet against the closing plate, pressure being exerted by dummy ring *D* to expand the billet to the full diameter of the container. This insures that when the hole is pierced through the billet it will be concentric.

Next the stem is withdrawn to the position seen in Fig. 7 and the mandrel is pushed into the billet to pierce a blind hole, thus forming a heavy cup. In order to prevent the dummy ring and mandrel from becoming excessively hot, the dummy ring is wiped with a cooling lubricant between operations and air blasts are directed on the mandrel. The air blasts are delivered through vents in a cover that is slipped over the mandrel between operations of the press.

At the end of the cupping and piercing operation, the mandrel is withdrawn from the billet and the container is moved toward the left, as viewed from the front of the machine, away from the closing plate, so that the latter can be withdrawn vertically. The container is then returned to the right to bring its right-hand end against the extrusion die *F*, as seen in Fig. 8. This die is mounted on another heavy horizontal slide or carrier.

The mandrel is then again advanced to push out the bottom of the billet, producing a slug *G*, Fig. 9, which is of slightly larger diameter than

Fig. 5. An Elevator at the Foot of the Conveyor Lifts the Billet and Swivels it into Line with Piercing Mandrel and Extruding Stem

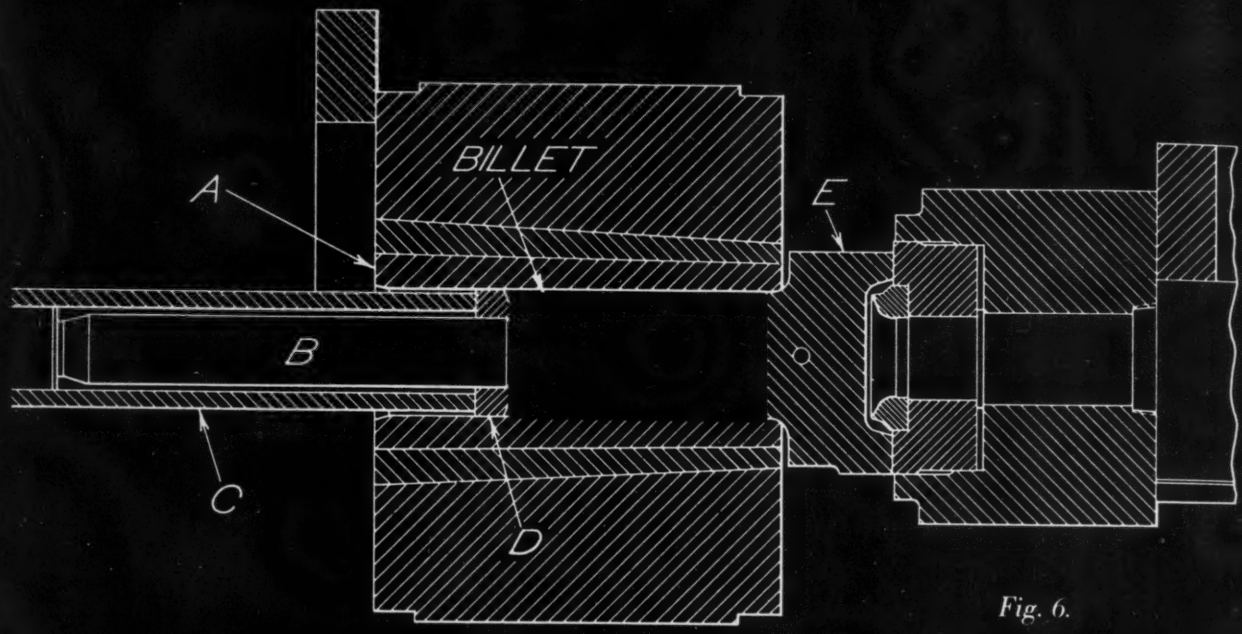


Fig. 6.

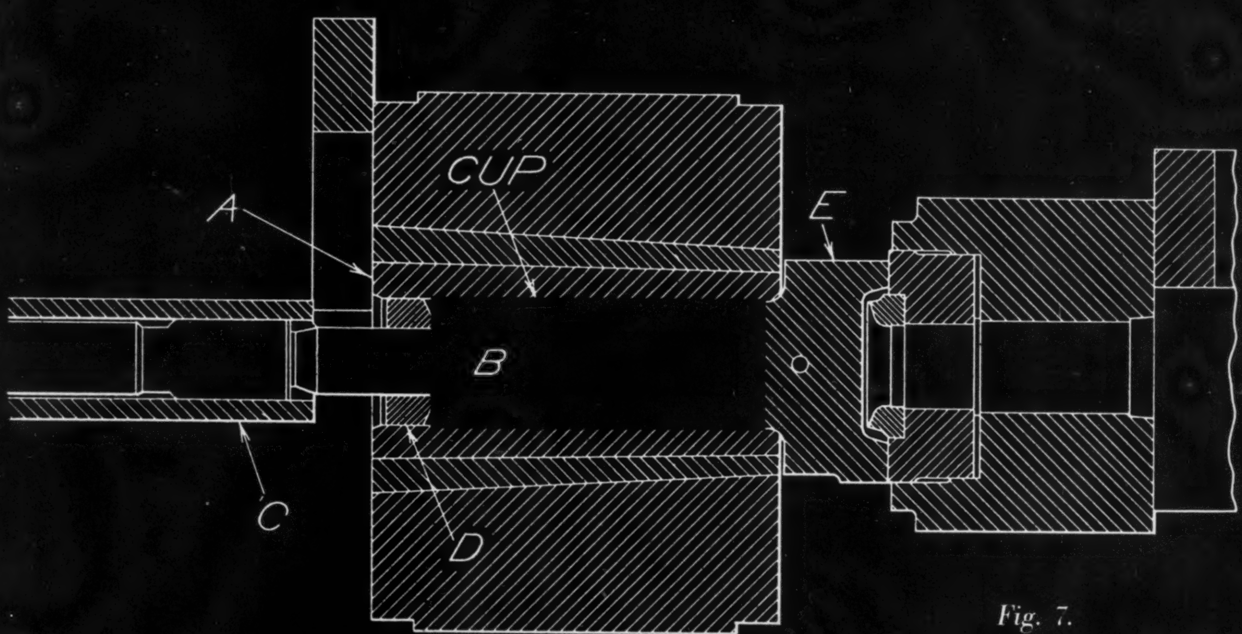


Fig. 7.

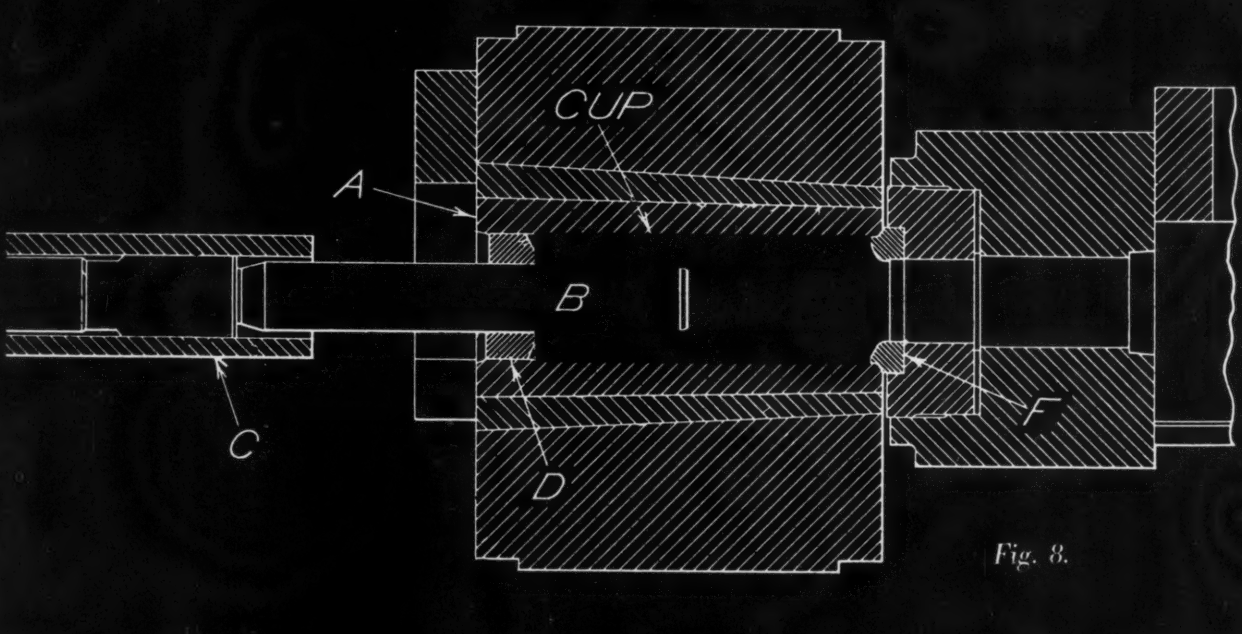


Fig. 8.

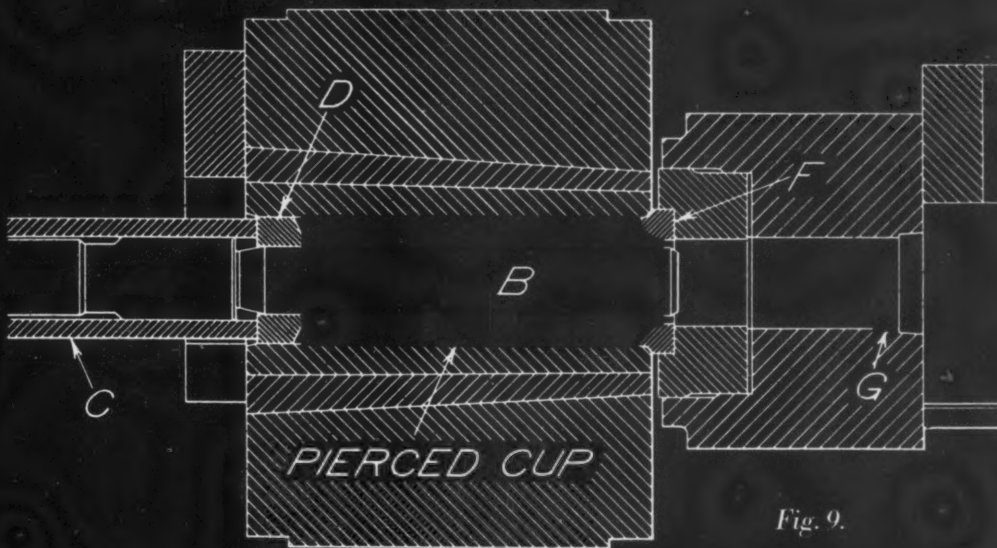


Fig. 9.

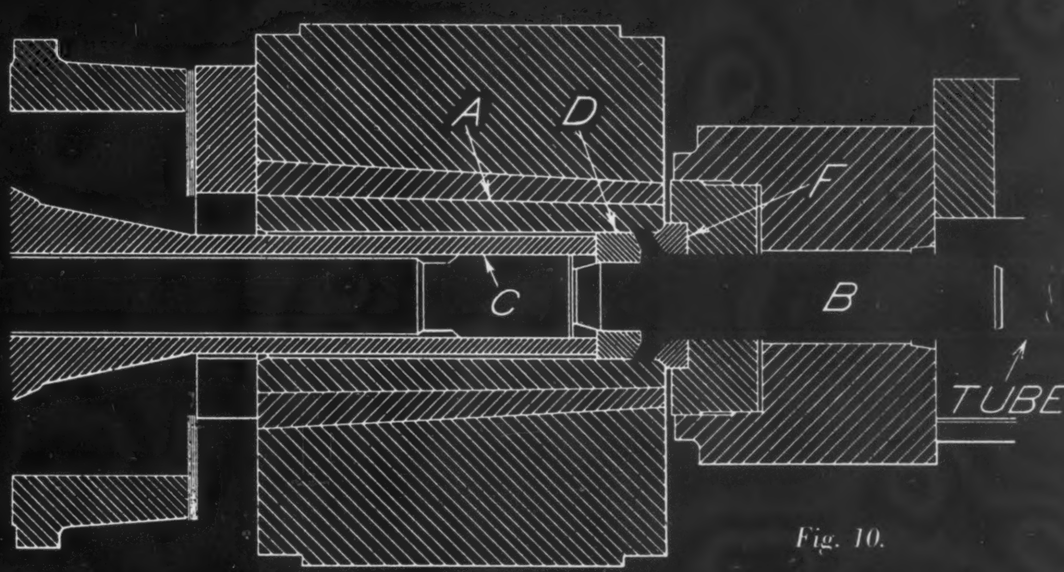


Fig. 10.

Fig. 6. Diagram which Shows the Heated Billet Pushed into Container by Means of Mandrel B, Stem C, and Dummy Ring D, with the Container Closed by Plate E

Fig. 7. A Hole is Pierced in the Billet by Mandrel B. While This is in Progress, Stem C is Withdrawn in Order to Enable the Billet Metal to Flow back along the Mandrel, thus Forming a Heavy Cup

Fig. 8. Diagram which Shows the Container in Contact with the Extrusion Die F, the Closing Plate E having been Lifted from in Front of Die

Fig. 9. Mandrel B is again Advanced to Complete Piercing of the Hole in the Cup

Fig. 10. Extrusion of the Tube Occurs as Stem C Pushes Dummy Ring D forward from the Position Illustrated in Fig. 9, the Mandrel Advancing at the Same Speed

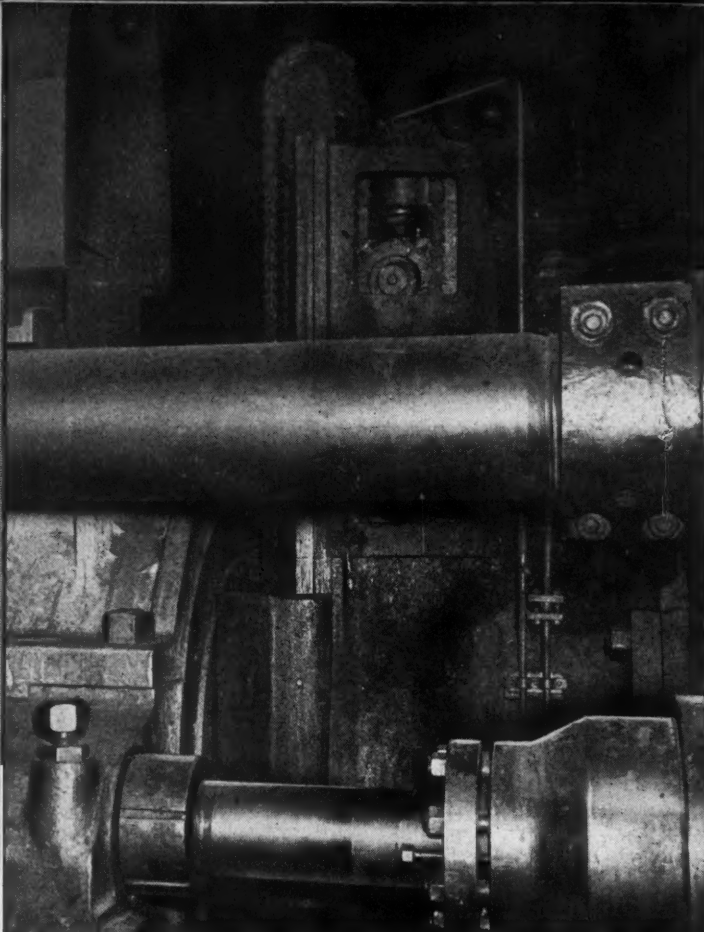


Fig. 11. A Vertical Slide on the 4000-ton Press Carries the Plate that Closes the Container during the Piercing Operation

the pierced billet hole. After the mandrel has been fed through the die opening, the stem advances with the mandrel and forces nearly all of the billet stock through the cylindrical opening between the mandrel *B* and the die *F*, as seen in Fig. 10, thus extruding a tube. A small amount of unextruded billet stock remains in the container in the form of a flange that is integral with the extruded tube. During all the steps of the operation up to this point the die unit has been held stationary by a heavy horseshoe-shaped casting, which transfers the full load to the press platen.

After the extrusion has been completed, the flange of unextruded stock must be removed from the end of the tube which leaves the die last. The accuracy of the outside diameter of the tubes is controlled by the die, and the accuracy of the inside diameter by the mandrel. In the case of the rotating shell-band tubing, the tolerance on both inside and outside diameters is plus or minus 1/32 inch.

At the end of the extruding operation, the horseshoe locking casting is lifted from in back of the carrier and the latter is moved to the right to a combination sawing and shearing machine for cutting off the unextruded scrap. The saw, which may be seen in Fig. 13, is generally employed for the operations on the gilding metal tubes, but the shear is used for many nickel-alloy tubes. At the end of the scrap removing operation, an ejector pin mounted on a swiveling member, as seen at the left in the

Fig. 12. The Piercing Mandrel and Pressing Stem are Here Seen Advancing to Push the Billet into the Container

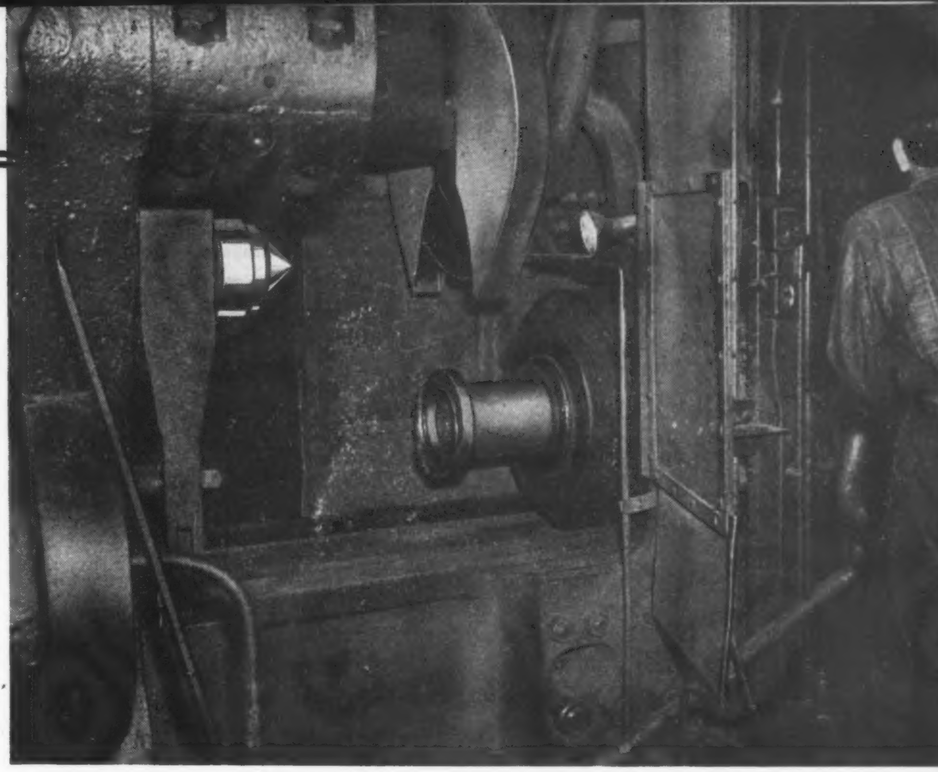


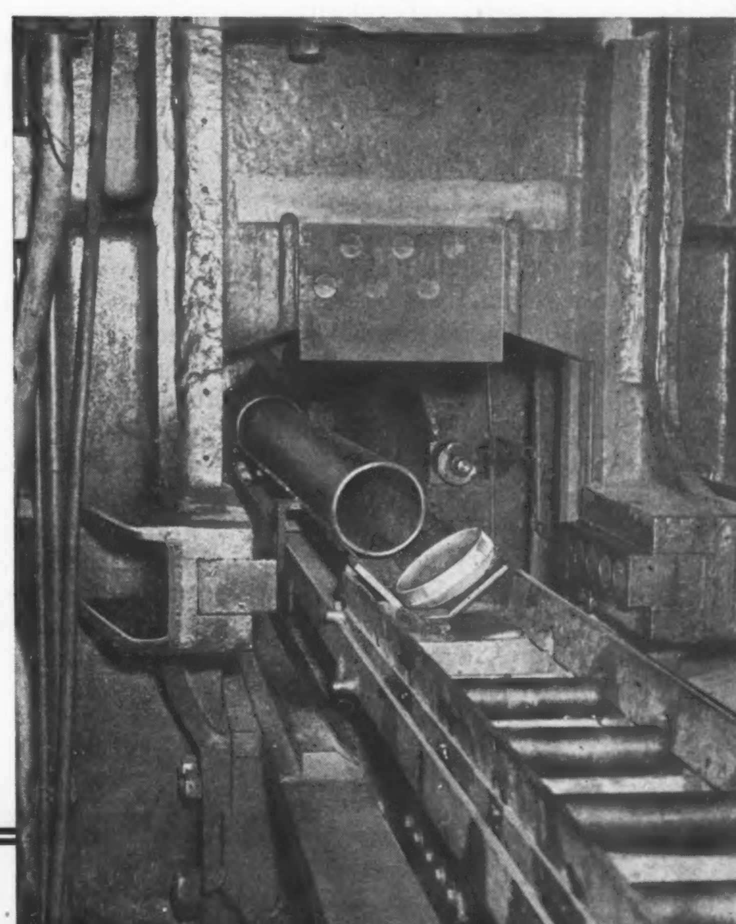
Fig. 13. The Sawing and Shearing Machine at the Right-hand End of the Extrusion Press, which is Employed to Remove the Flange of Unextruded Metal from the Tubes

illustration, is swung down into line with the finished tube. The tube is ejected from the die carrier by moving the latter back toward the press so that the ejector pin can push the tube out.

The die carrier then returns farther to the left into the working position for the next operation. The finished tube is discharged on a roller conveyor, as seen in Fig. 14, which leads to a transfer point from which the tubes go to lathes to be cut up into the shell bands.

This hydraulic press is equipped with two cylinders, a 2500-ton main cylinder, which acts on the stem and provides the high pressure required for extrusion, and a 1500-ton cylinder, which supplies the pressure necessary for piercing the billet in the container. The capacity of this cylinder is also applied to the stem during extrusion. Pressure is supplied to the machine from an air-loaded accumulator in which water is maintained at a pressure of 4250 pounds per square inch by two pumps driven by 400-H.P. motors. A low-pressure prefilling system effects the idle movements of the stem and mandrel. Water under pressure supplied from the high-pressure accumulators is applied for the short piercing and extruding strokes. The auxiliary cylinders of the press, which operate the container slide, die carriage, billet elevator, etc., are supplied only with high-pressure water from the accumulators. At the end of each operation, all of the high-pressure water used goes to an overhead tank which feeds the pumps.

Fig. 14. Another View of the Shearing and Sawing Machine, Showing a Completed Tube and, Lying in Front of It, the Slug of Metal that is Pierced from the Cup at the Beginning of the Extruding Operation



Shot Peening Now Widely Used

A Process that in the Days before the War was Employed Primarily for Strengthening Springs is Now Applied to a Wide Variety of Parts, Including Gears, Crankshafts, Connecting-Rods, and Even Aircraft Propeller Blades

By CHARLES O. HERB

IMPORTANT advances have been made during the war production era in the application of shot peening for increasing the fatigue resistance of stressed metal parts. This process was mainly applied before the war for strengthening leaf and coil springs required in automotive production. During the war period, however, the process has been widely adopted for a variety of parts used in the drives of tanks, jeeps, airplanes, and other fighting equipment. The wartime applications point to an even wider utilization of the process in the manufacture of peacetime products when the war is ended.

Shot peening is a method of cold-working metal parts by subjecting the stressed surface of the parts to a rain of metallic shot thrown at a relatively high velocity. Each shot acts as a tiny peen hammer, making a small pit in the metal and stretching it radially. There is a plastic flow of the surface fibers beyond their yield point in tension throughout a layer which extends from 0.005 to 0.010 inch in depth below the surface.

The fibers underneath this top layer, however, are not stretched to their yield point, and therefore retain their elasticity. These under fibers are, of course, bonded to the stretched surface layer, and after the peening action, the inner fibers force the outer fibers to return to a shorter length than that at which the stretched fibers would tend to remain. In the equilibrium that results, the surface fibers are in residual compression, while the inner fibers are in tension.

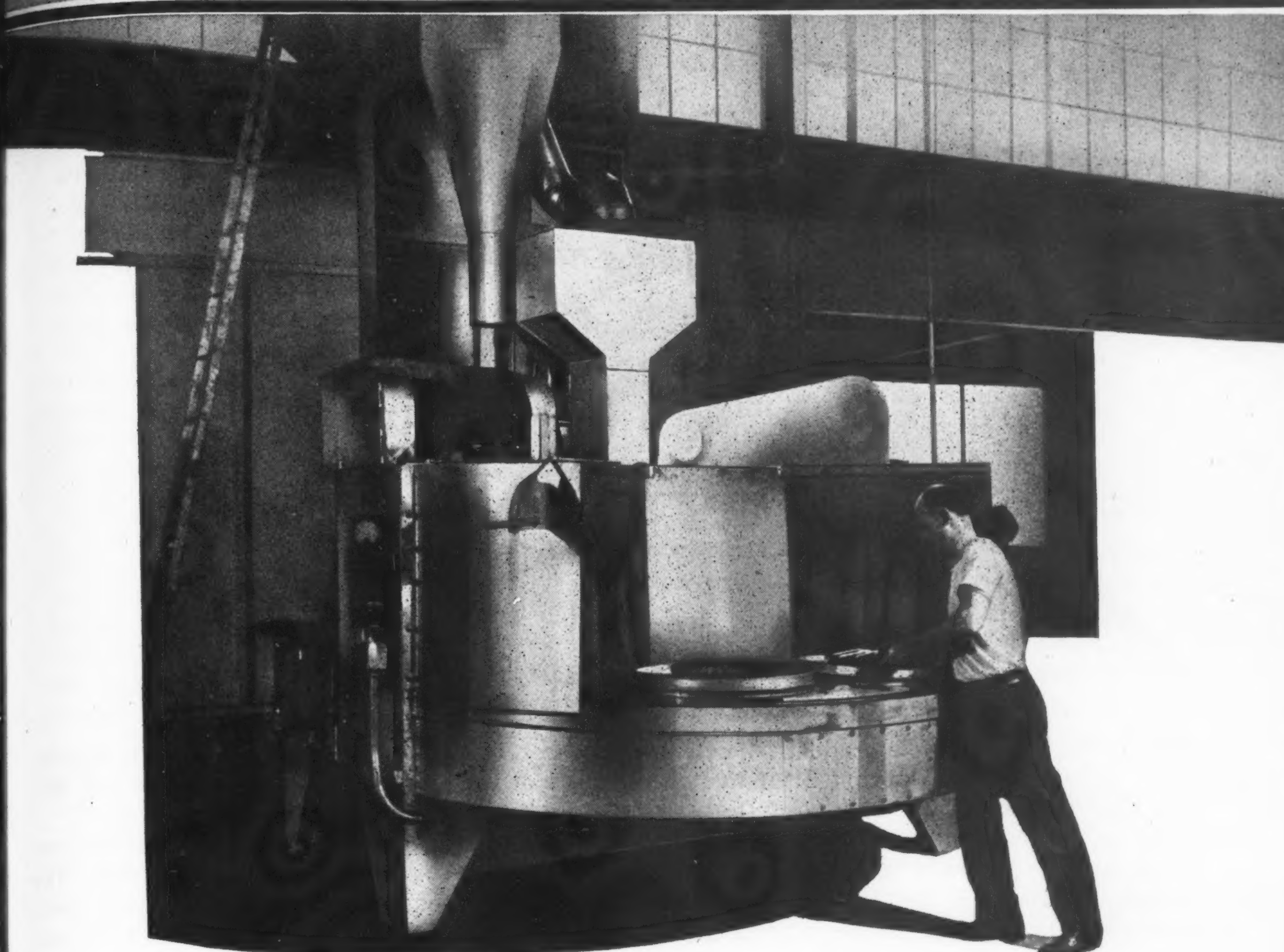
Laboratory tests have indicated that the surface compression stress is several times greater than the tension stress in the interior of the section. Therefore, when working stresses are applied that would ordinarily increase the tension stress on the surface, they are offset by the residual stress in the surface layer. Since fatigue failures generally result from tension stresses and not from compressive stresses, the result is a considerably greater fatigue life.

One of the outstanding advantages, obviously, of shot peening is that it provides an economical means of substantially increasing the strength of working parts without necessitating any increase in their weight. As an indication of the improvement in fatigue resistance that is obtainable by peening, it may be mentioned that laboratory tests conducted by J. O. Almen of the Research Laboratories Division of General Motors Corporation show that shot peening has increased the life of hypoid gears as much as 600 per cent; aircraft engine crankshafts, 900 per cent; steering knuckles, 475 per cent; welded joints, 310 per cent; transmission main shafts, 520 per cent; and helical springs, 1370 per cent.

Two methods of shot peening have been developed. In the process that is most widely used, the shot is thrown on the work from a centrifugal wheel that revolves at high speed, while in the second method, the shot is directed on the work by compressed air. The first-mentioned method, as carried out in Wheelabrators built by the American Foundry Equipment Co., Mishawaka, Ind., will be treated in this article.

In this shot peening method, one type of equipment consists of a machine equipped with a large-diameter rotating table on which there is a series of smaller stands or tables for carrying the work to the shot blast. A machine of this type is shown in the heading illustration. The smaller work-tables are held stationary on their axes as they pass through the loading and unloading stations, but they revolve on their axes as they are carried beneath the shot blast,

for Increasing Fatigue Resistance



so as to insure that the blast will be directed uniformly around the surface or surfaces being peened.

Machines are also available in a design in which the work-pieces are fed in a direct-line motion past the stream of shot. Machines of this construction are particularly intended for handling long parts, such as leaf springs, which are to be peened along one surface only rather than completely around a cylindrical section. In machines of this type, the work is carried through the machine by an endless belt or chain.

Special machines are also built to meet unusual conditions. A machine designed for peening airplane propeller blades, for example, has a carriage or slide which lowers the propeller blade a distance of several feet from the loading position for the performance of the shot peening operation, and then raises it to the starting position. In other words, the work-slide merely moves up and down. The propeller blade is held vertically on the slide.

On all of these machines the shot is delivered by a bladed wheel of the construction shown in Fig. 1, which is revolved at a peripheral speed of approximately 11,500 feet per minute, although the speed can be adjusted to suit varying conditions. Shot is fed from a hopper *A* to the center of the wheel, where there is a small impeller *B* which rotates with the wheel proper and carries the shot to an opening in a stationary control cage *C*.

The shot is discharged through the opening to the wheel blades *D*. It is picked up by the inner

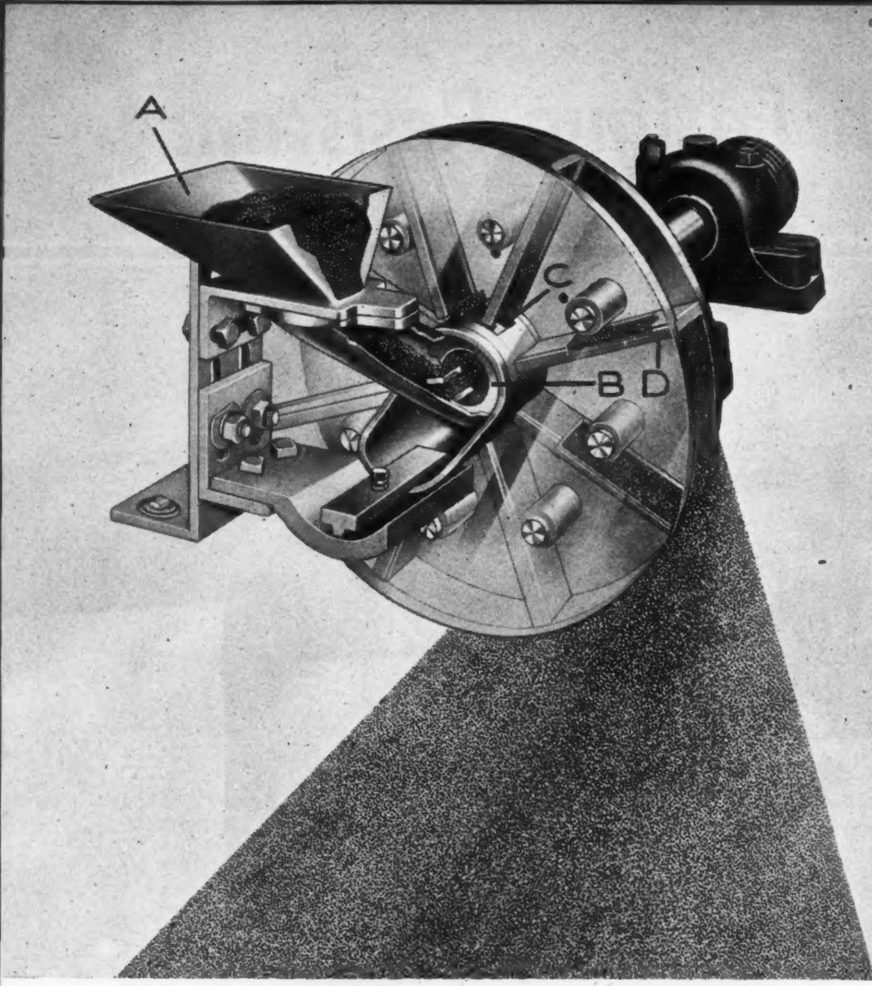


Fig. 1. Phantom View of Blast Wheel on Wheelabrator Shot Peening Machines, Showing Movement of the Shot from the Time It Leaves the Hopper until It is Thrown from Wheel Periphery

ends of the blades and is gradually accelerated in its movement to the periphery of the wheel. The final velocity of the shot as it leaves the wheel is the resultant of radial and tangential forces and is generally about 13,000 feet per minute. Changes in the direction of the shot stream can be obtained by merely turning the control cage to alter the position of the cage opening.

The closer the control of shot peening operations, the more accurate are the results. Such factors must be taken into consideration as the duration of exposure of the work to the shot; the size and hardness of the shot; the velocity of the shot; the work coverage and direction of the shot; the rate of shot breakdown and removal; and finally, the hardness and other physical properties of the work.

In order to insure effective peening of fillets and other surface irregularities, the shot must be small enough to cold-work the surfaces involved. Therefore, the radius of the shot should be less than the radius of the smallest fillet or surface irregularity. The larger the size of the shot, the deeper will be the surface layer that is put under compressive stress. Obviously, with thin pieces, shot of small diameter should be used. The size of the shot affects the appearance of the peened part. Smaller shot will produce a finer matte surface.

The rearrangement of physical surface structure should be taken into consideration. The larger the shot, the greater the rearrangement. With parts that must be held to close tolerance, the surface structure displacement should be small. It is desirable that the shot be at least as hard as the work and tough enough to resist fracture. The size of shot used in peening usually varies from S A E P-16 to P-66. In this classification, the number indicates the size of the shot in thousandths of an inch with certain tolerances above and below the diameter.

The velocity that must be imparted to shot to meet specified peening intensities depends upon its size and hardness. The energy of the shot varies with its mass and velocity. If the mass—that is, weight—is changed, it is necessary to change the velocity in order to maintain the same peening intensity. In Wheelabrator machines, the shot velocity can be varied by changing the speed or size of the wheel.

To be effective as a peening agent, shot must retain its spherical shape. When fracture occurs, the shot breaks down into grit, which has an

abrading effect. It is extremely important, therefore, that broken shot be removed from the machine as quickly as possible. On Wheelabrator machines this is accomplished by a special separator. There is also an automatic mechanism for adding new shot in the same quantity as the broken shot removed.

In setting up a production operation, it is desirable to determine by laboratory methods the amount of shot peening that will give the most satisfactory results. In all fatigue tests conducted to determine the benefits of shot peening, it is important that the shot-peened parts fail at the same location as the unpeened parts. Otherwise, a true check of the value of shot peening is not obtained.

A method developed by J. O. Almen has been accepted as the best means of measuring the peening intensity of the shot peening process. This inspection method is based on the principle that if a thin flat strip of hard steel is shot peened on one surface only, the stretching of the surface fibers will cause the strip to assume a curved shape. The amount of this curvature is, therefore, a measure of the compressive stress to which the specimen was subjected. In practice, the thin test strip is attached to a simple steel block by screws in such a manner that it is held flat during and after peening, until it is released from the block. Then it assumes its curved shape.

Gages were devised by Mr. Almen to measure this curvature of the test strip or "arc height" in a length of 1 1/4 inches. Each gage has a dial that is graduated in thousandths of an inch. On the latest type of gage the test strip is placed against four ball contacts in such a way that the dial can register a combination of the arc both longitudinally and transversely on the strip. Measurements are taken on the concave smooth side of the test strip, so as to avoid any variations due to roughness of the peened surface.

There are two sizes of Almen test strips in general use, an "A2" strip intended for light work on which the arc height will not exceed 0.026 inch (the thickness of this strip is 0.0510 inch within plus or minus 0.001 inch) and a "C" strip that is intended for use on heavier work. The "C" strip allows a higher intensity of shot peening before the strip saturation point is reached. The strip has a thickness of 0.0938 inch within plus or minus 0.001 inch. Both strips are 3 inches in length by 3/4 inch in width.

These Almen test strips are used not only in setting up a production job, but also in maintaining a periodic check on the operation. When a job is first started in production, tests should be taken at least hourly, and in practically all work, they should be taken several times a day to insure that the peening objectives are being obtained. Any variation from the standard peening intensity that has been established requires a check-up on the various factors that affect the intensity.

Two blocks with Almen strips may be seen at *A*, Fig. 3, attached to fillets of a dummy crankshaft, ready to be conveyed through a shot peening operation. The strips occupy the same positions as the areas on actual crankshafts that are shot peened in this operation, and thus permit a true reading of the peening intensity that is being imparted to the work.

In the operation shown in the heading illustration, 18-inch spiral bevel gears for truck

Fig. 2. Tread Pins for Military Tanks are Production Shot Peened in a Machine Equipped with an Endless Rubber Belt Conveyor that Carries the Pins beneath Two Blasts of Steel Shot, One Directed at Each End of the Pins

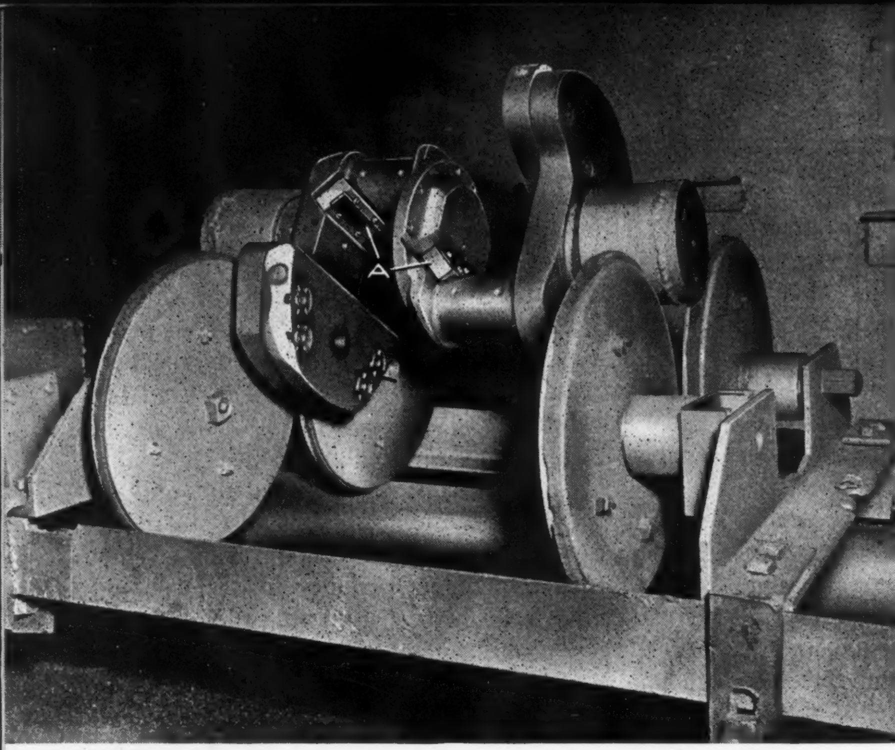


Fig. 3. Method of Using Almen Test Strips to Determine the Peening Intensities Produced in Critical Areas of a Crankshaft

differentials are shot peened on the teeth. The large rotating table of this machine is 6 feet 9 1/2 inches in diameter, and it is equipped with eight smaller work-tables, somewhat larger than the gears they are designed to accommodate. When the gears leave the loading station and when they return for unloading, they pass under several rubber curtains, which are slit to permit passage of the work-tables. These curtains prevent the steel shot from ricocheting outside of the machine, and it is general practice to provide them on all shot peening equipment. It is also general practice to protect with rubber padding all surfaces of the large and small tables that are exposed to the steel shot. Inside the machine, rubber is used to protect structural members from the shot.

Peening of gears is performed without distortion of the tooth form, and some shop men claim that peened gears operate more quietly than unpeened gears. On most gears, the maximum bending stress is in the fillets at the root, but in coarse-pitch gears with a large pressure angle, the maximum bending stress may be on the tooth flanks. Shot peening can be directed primarily either on the roots or the flanks of gear teeth.

The Ford Motor Co. shot peens ring gears and pinions for trucks, armored cars, etc. An operation on spiral bevel ring gears of 12 7/8 inches outside diameter is illustrated in Fig. 4. At a torque load of 78,400 inch-pounds, the fatigue life of unpeened gears averaged 125,000 revolutions of the pinion. Peened gears have a fatigue

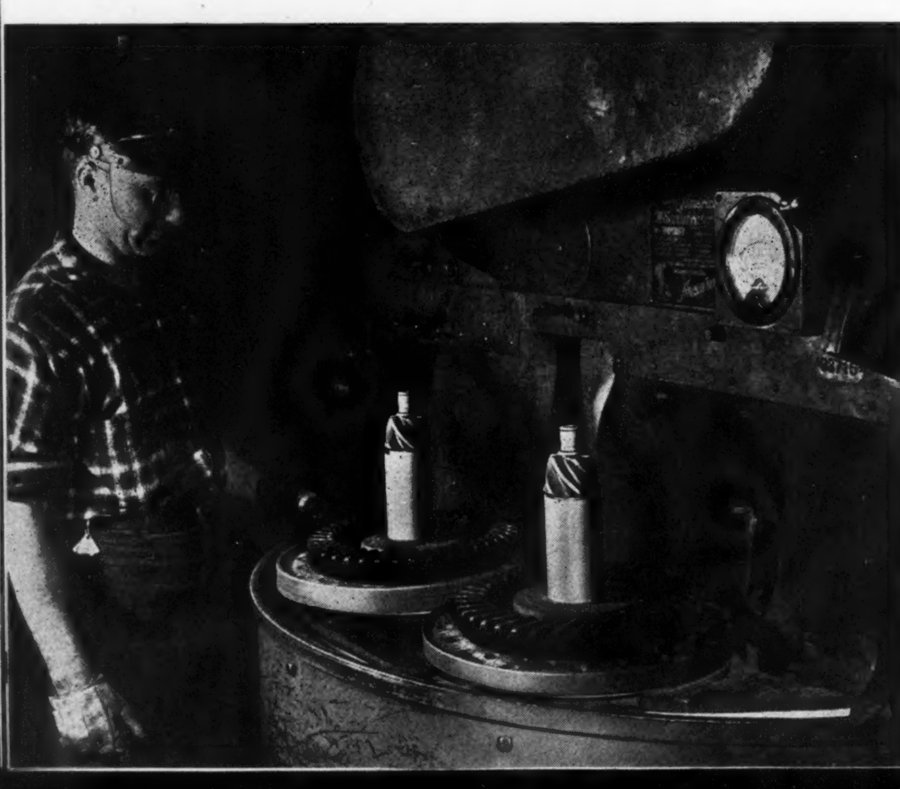


Fig. 4. Ring Gears and Pinions are Placed together on Work-tables of a Shot Peening Machine in the Ford Plant for Simultaneously Peening the Teeth of Each

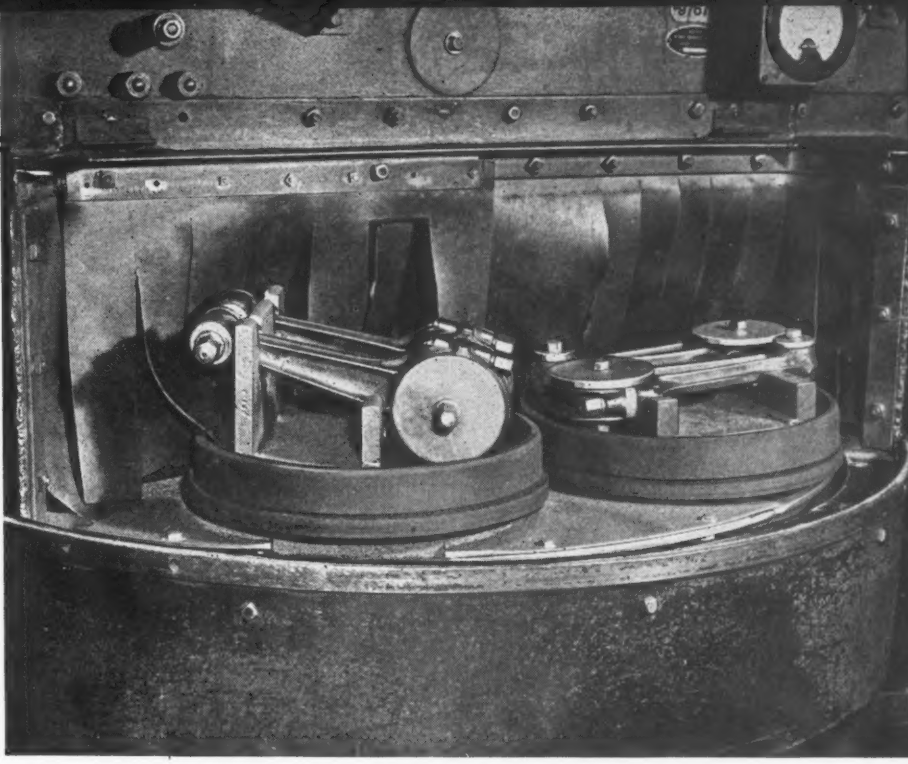


Fig. 5. Connecting-rods are Shot Peened all over in Four Passes through This Machine to Increase the Fatigue Resistance of These Parts

life of more than twice that number of pinion revolutions with the same torque load. Gears no longer fail at the roots of the teeth, and when failure finally occurs in the tests, it consists of a crumbling of the tooth flanks.

Approximately 900 sets of ring gears and pinions are shot peened per day of twenty-four hours in a machine of the type illustrated. When the gears reach the shot-blast area, the work-tables are revolved, so that all portions of the roots and the load side of the teeth are brought into direct line with the shot. This equipment, as well as all other shot peening machines in the Ford plant, is provided with an ammeter which indicates the electrical energy being expended in performing the operation. The ammeter is an index of the power consumed by the Wheelabrator motor in throwing shot. The amount of power consumed is directly proportional to the amount of shot thrown by the Wheelabrator; hence the ammeter reading is an index to the amount of shot being thrown at any one time. The gears and pinions are shot peened as they arrive on overhead conveyors direct from heat-treating operations.

It is the Ford custom, once a shot peening operation has been established in production, to have the operator run an Almen test strip through the machine at least once for every eight-hour shift to see that the specified arc height is being obtained. Also, a man from the metallurgical and chemical laboratory visits each machine at least once a day to make a similar check. The laboratory man makes the visit dur-

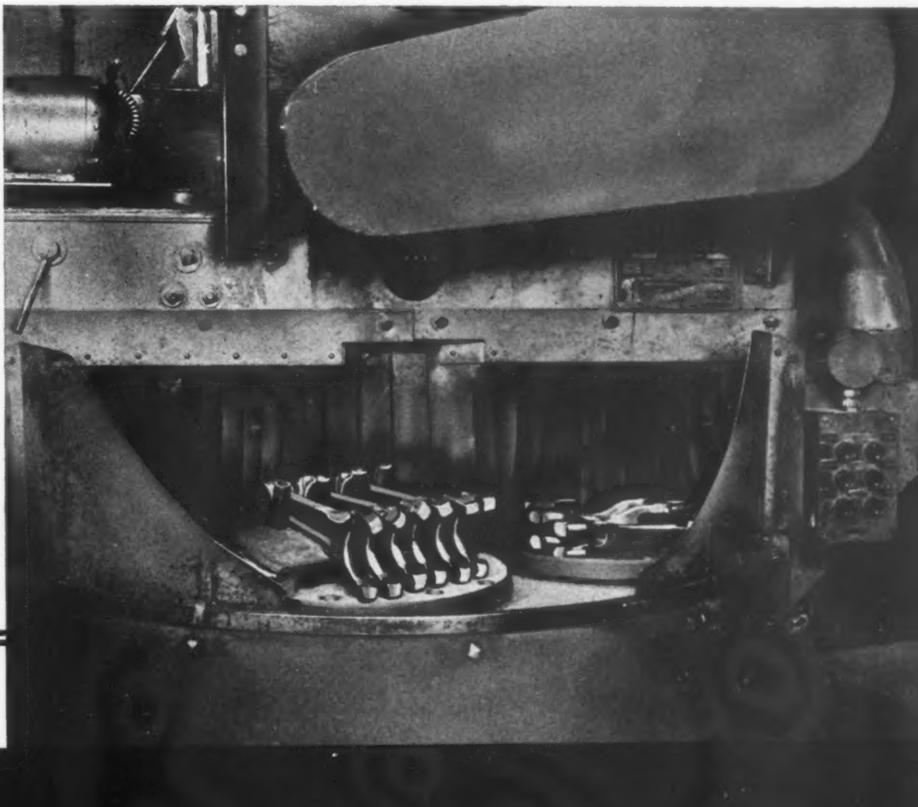


Fig. 6. A Similar Shot Peening Operation Performed on Connecting-rods at Cadillac Motor Co.'s Plant. These Rods are also Passed through the Machine Four Times

ing different hours of the day, so that the machine operator never knows just when the laboratory check will be made. Consequently he keeps close observation of the operation at all times. About 50 pounds of shot per hour are added in shot peening operations at the Ford plant. Shot of S A E P-23 specification is used in all operations.

Tractor tread pins are peened on opposite ends at the rate of 1200 pins an hour at the plant of the Ohio Rubber Co. on a special machine, the unloading end of which is illustrated in Fig. 2. They are peened only around fillets where the ends join the first bosses. The pins are carried through the shot-blast zone by an endless rubber belt conveyor equipped with suitable clips for holding them in place. The tread pins are revolved as they pass beneath two shot wheels. One wheel directs a blast of shot on one end of the pins, and the second wheel on the opposite end of the pins. The life of these tank tread pins has been about tripled by peening.

Connecting-rods for tank engines are peened all over, with the exception of the bearings, in four passes through the machine illustrated in Fig. 5 in the Ford plant. The bearings are protected from the action of the shot by metal disks, which are bolted to the bearing ends. The peening intensity in this operation is the same as that required to induce an arc height of 0.012 inch within plus or minus 0.002 inch on an Almen "A" strip. There has not been a single failure in the field from fatigue since shot peening was adopted to increase the strength of these connecting-rods.

After the rods have gone through the machine twice in the fixture seen at the right (the rods being turned upside down between the two passes), they are transferred to a fixture such as seen at the left. The rods are also reversed in this fixture between two passes, so as to insure complete peening all over. About three hundred rods are peened per eight-hour shift.

Somewhat similar equipment is employed by

Fig. 7. Shot Peening Tank-engine Quills with the Gear Ends Protected by Square Mask Castings, which also Permit of Indexing the Quills between Four Successive Passes beneath the Shot Blast

the Cadillac Motor Co. in shot peening connecting-rods all over. This operation is illustrated in Fig. 6. In this operation, as well as in the one previously described, the work-tables are revolved on their own axes as they are carried under the stream of shot.

Quills for tank-engine applications are seen in Fig. 7 on the tables of another shot peening machine in the Ford plant. The quills are made with a gear at each end, and these gears must be protected from the shot. This is accomplished by enclosing the gear ends in square blocks, which also provide a means of indexing the quills between four passes of the machine. The quills must be peened all around, and it is for this reason that they are run four times through the peening machine. It is of interest to note that after three passes have been made, the quills have a deflection in the center of 0.003 to 0.004 inch. The fourth pass straightens them.

In the fatigue tests performed on these quills, the parts are twisted 8 degrees. Peening more than doubles their life; whereas unpeened quills would fail after about 70,000 cycles, the peened quills withstand at least 150,000 cycles.

A unique method was devised by Ford engineers for automatically revolving long, slender generator shafts during shot peening to insure uniformity of peening all around the shafts. Both ends of this shaft must be protected from the shot, and to accomplish this, castings are slipped over them. One of these castings, as seen in Fig. 8, is provided with radial fins. When the work-pieces move into position beneath the stream of shot, the force of the shot striking the fins causes the entire part to rotate at a relatively high speed on its own axis. The tables also revolve on their axes, as on most machines of this type. On the right-hand table may be seen at test strip about to go through the peening operation with two of the generator shafts.

Leaf springs for automotive applications have been peened for some years by the Ford Motor Co. on machines of the type illustrated in Fig. 9.

Fig. 8. Shot Peening Slender Generator Shafts with a Finned Casting on One End that Causes Rotation of the Shafts on their Axes as They are Carried beneath the Shot Blast

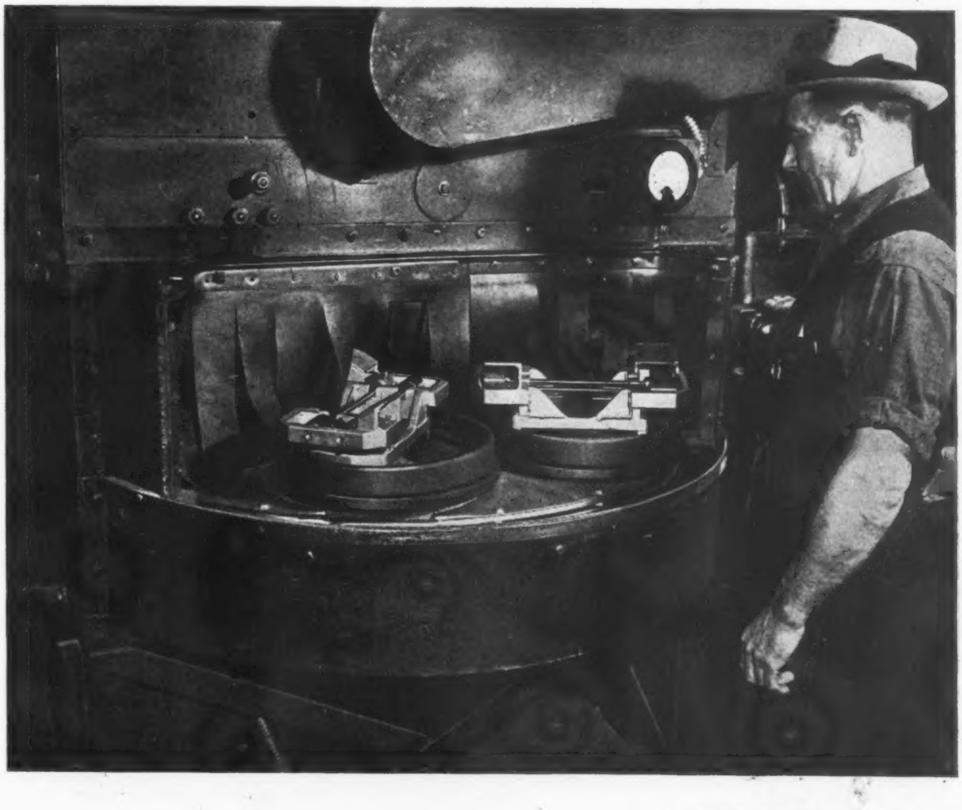


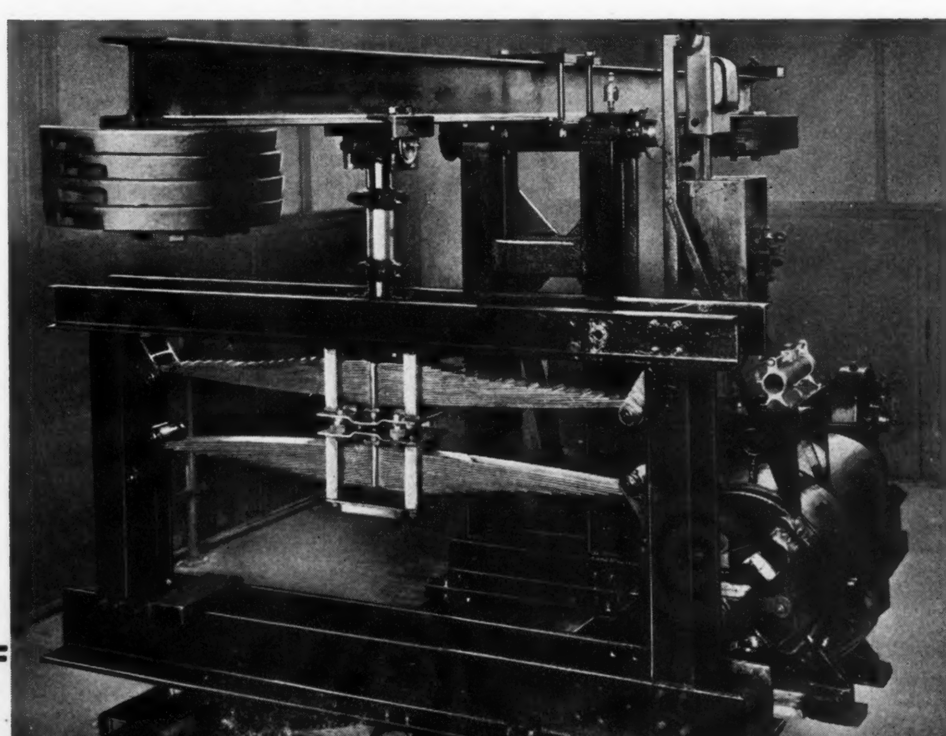
Fig. 9. Shot Peening Operation on Automotive Leaf Springs, which is Typical of the Manner in which the Process is Carried out in a Number of Plants

An endless link conveyor carries the parts through the machine. Jeep springs were being handled at the time that the photograph was taken. One type of leaf spring assembly that is required to withstand 300,000 cycles of deflection without being peened will undergo at least 600,000 cycles after being peened.

Leaf springs are peened on the concave or tension side only. Spring leaves are taken from each heat of steel and tested for fatigue resistance after they have been assembled into complete springs.

Torsion bars 5 to 6 feet in length are shot peened their entire length in a machine, of which

Fig. 10. Fatigue Testing Machine Used on Leaf Springs in the Laboratory of the Studebaker Corporation. This Machine, which is of the Walking Beam Type, is Shown Testing Two Springs Simultaneously



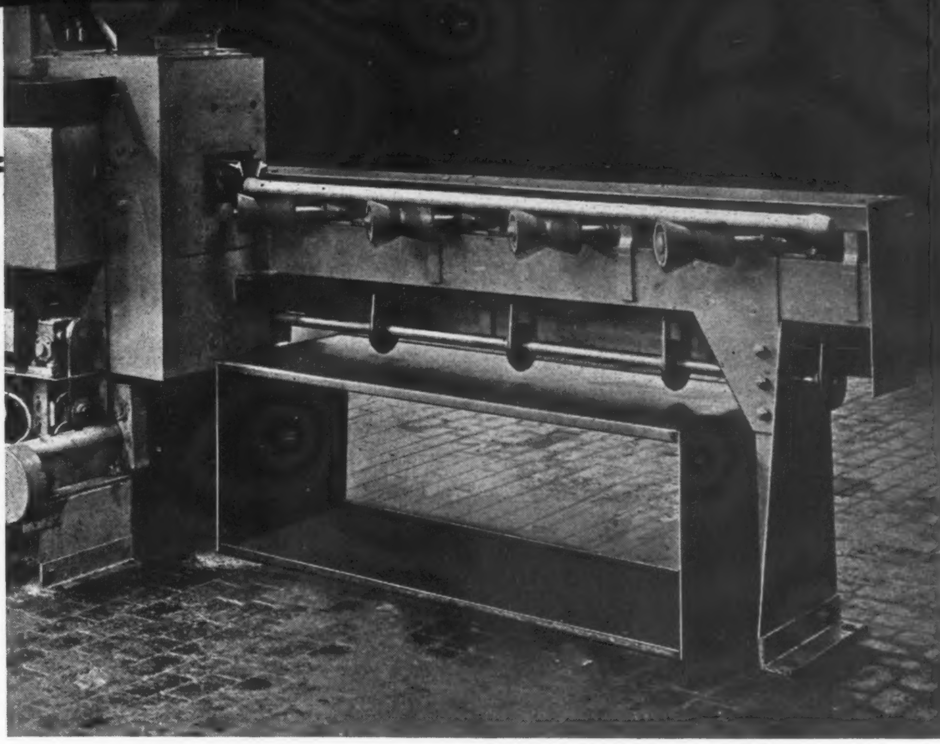


Fig. 11. Long Torsion Rods are Fed through a Shot Peening Operation by a Unique Arrangement of Tapered Rollers, which Simultaneously Revolve the Torsion Rods on their Own Axes and Feed Them through the Equipment

one end is illustrated in Fig. 11. Rollers of opposed taper, mounted on shafts set at an angle to the line of motion, feed the torsion bars through the machine and onto an unloading table at the opposite end. The torsion bars revolve on their axes as they pass through the machine, so as to insure uniform peening all around, as well as for the full length. These torsion bars are being used on tanks, jeeps, and trucks in place of springs.

Recent Improvements in High-Strength Cast Irons and Cast Steels

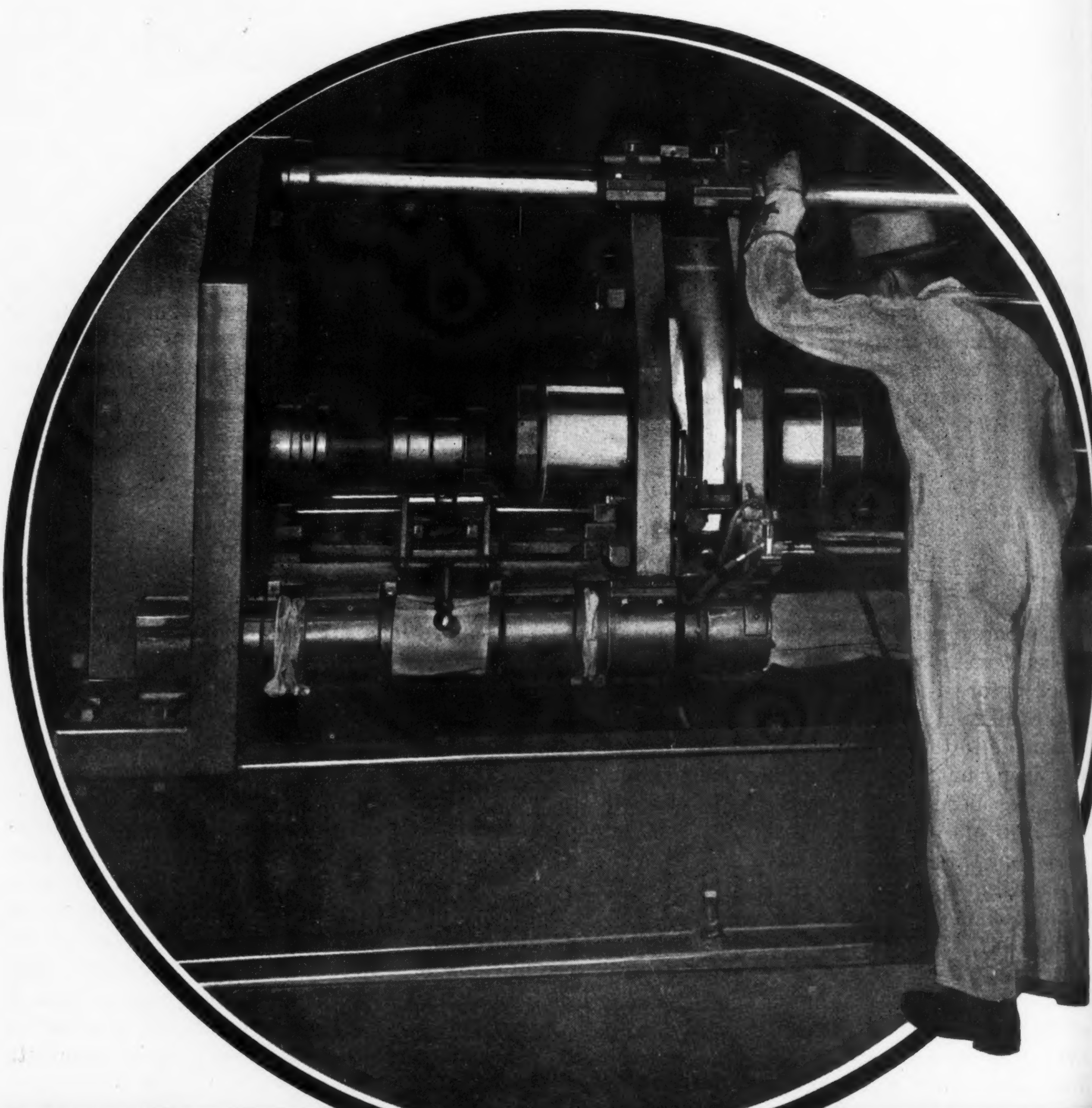
IN a paper reviewing recent developments in engineering materials, read by Archibald Black before the annual meeting of the American Society of Mechanical Engineers, reference was made to the present status of high-strength cast irons and cast steels. So much improvement has been made in the tensile strength of cast iron and cast steel within the last decade or so that these materials have to be considered in the light of current experience rather than in that of older text-book figures.

By 1941, the American Society for Testing Materials' specifications for cast iron covered eight classes, with maximum tensile strengths of 20,000 to 60,000 pounds per square inch. Even this is not now the maximum, for cast irons with tensile strengths up to 80,000 pounds per square inch are now made for special purposes. The greater strength has resulted mainly from improved melting practices, the addition of alloys, and heat-treatment.

Somewhat similar progress has been made in the melting technique, control of inclusions, and deoxidation of cast steels. For these, the American Society for Testing Materials' specifications now range up to 150,000 pounds per square inch tensile strength, with a yield point of over 125,000 pounds per square inch and a minimum elongation of 10 per cent. In other steels of the "chrome-moly" type, the tensile strength runs up to 205,000 pounds per square inch, with 5 per cent elongation. Here the improvement is due mainly to the addition of alloying elements and to heat-treatment.

Oxy-Acetylene Pressure Welding

This Method of Welding, which was Originally Applied to Operations in the Railway and Oil Fields, is being Increasingly Employed in Factory Production



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Has Wide Production Possibilities

OXY-ACETYLENE pressure welding is an automatic process developed within the last few years by The Linde Air Products Company, in which the work-pieces are joined while in the solid state without the addition of any melted metal. In welding steel by this process, temperatures of 2100 to 2300 degrees F. are employed. Pressures of 2500 to 4500 pounds per square inch are applied to effect upsetting as the parts attain the proper degree of heat. This pressure-welding process is especially adaptable to the welding of high-carbon and alloy steels, which are welded with difficulty by fusion methods.

In oxy-acetylene pressure welding, the weld is made by a coalescence of grains across the interface. To produce this action, clean, square surfaces are first brought together under pressure and then heated to the required temperature. It is important that the work-pieces be heated uniformly through their entire sections in the vicinity of the joint. This is accomplished by directing a group of oxy-acetylene flames around the sections to be welded. Relative movement between the oxy-acetylene welding heads and the work is frequently necessary to produce even heating. The pressure-welded joint has a definite bulge or upset which varies in height with the thickness of the metal being welded. The bulge is characterized by smooth, well rounded fillets.

The several steps in an oxy-acetylene pressure-welding operation are illustrated diagrammatically in Fig. 1, which shows at *A* two steel bars to be welded together. These bars are first aligned in a machine, and then the square, smooth ends are forced firmly together by the application of a pressure amounting to, say, 3000 pounds per square inch, as at *B*. This pressure is maintained throughout the operation.

The bars are next heated by oxy-acetylene flames, as indicated at *C*. They are, of course, heated for some distance on each side of the interface, generally by moving the welding head back and forth sideways a distance of about one-half the bar diameter on each side of the interface. With such an arrangement, the metal adjacent to the interface, as well as the abutting surfaces, is brought to a temperature of, say, 2100 degrees F. This is well below solidus temperature—that is, the melting temperature of the lowest melting constituent in the steel.

As the work-pieces become heated beyond a certain temperature (which differs with the metal composition), the pressure applied on the abutting ends provides an upsetting action, as indicated at *D*. The welded work is held for a short time at the maximum temperature, and is then allowed to cool.

From this description it will be apparent that pressure welding requires equipment for applying end pressure, welding heads designed to provide uniform and controlled heating, and indicating and measuring devices for regulating the process throughout its cycle. The exact type of equipment to be used depends on the shape of the work and the location of the weld.

Some operations require rather complex equipment, whereas a simple press is entirely suitable for other operations. For joining long members such as railway rails and overland pipe, machines equipped with side clamping jaws are necessary, and several different types of these machines have been designed and are in use. Experience has shown that hydraulic or fluid pressure equipment is well suited for pressure-welding machines because it is readily variable, is subject to mechanical control, and will maintain pressure regardless of expansion or contraction of the pieces being welded.

The necessary capacity of the pressure equipment depends, of course, upon the size of the work. Most pressure welding of steel is being performed at pressures of from 2500 to 4000 pounds per square inch on the abutting surfaces. For welding steels that have high strength at high temperatures, such as chromium and chromium-nickel steels, it may be necessary to use

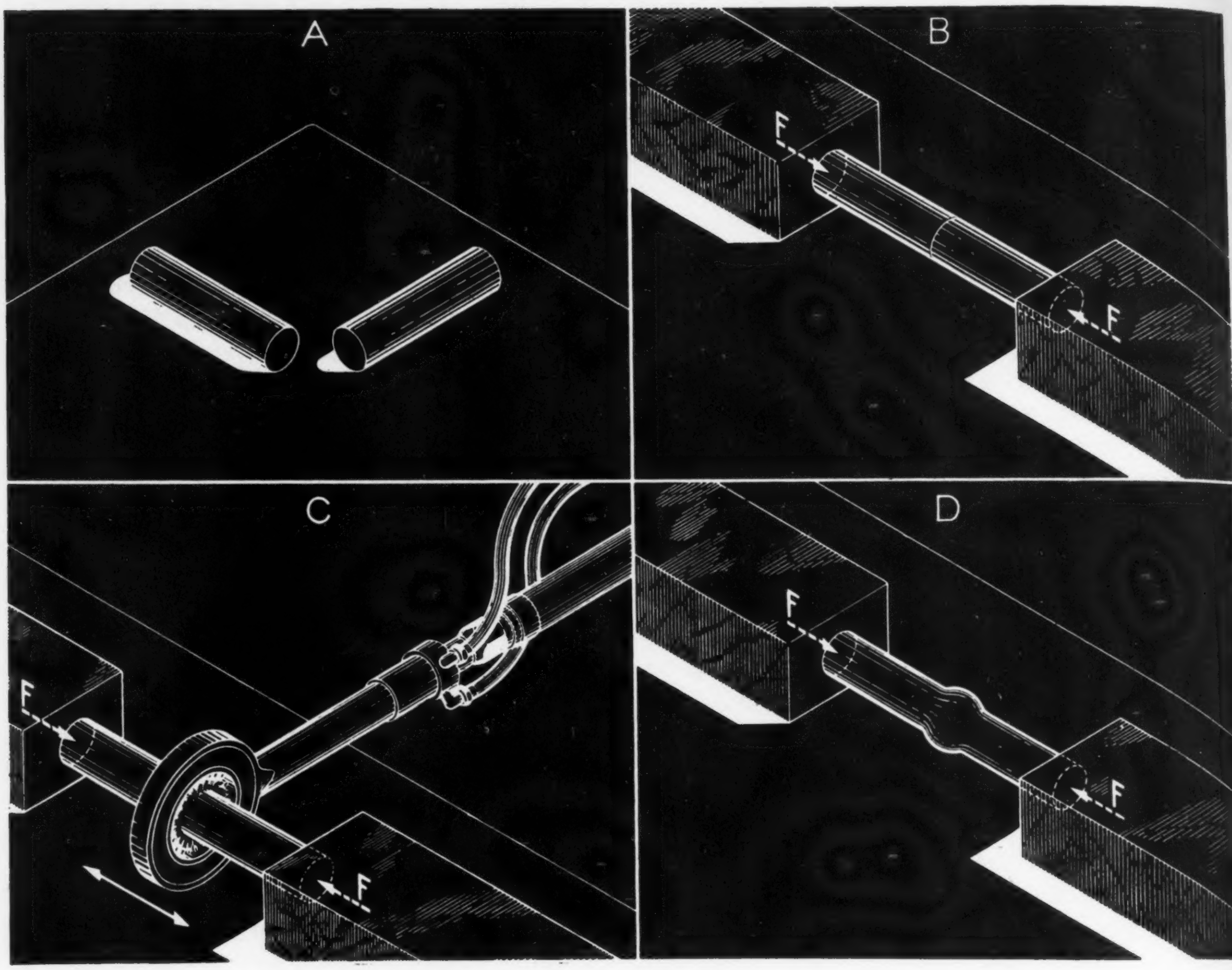


Fig. 1. Diagrams Indicating the Successive Steps in Oxy-acetylene Pressure-welding Operations in which the Two Work-pieces to be Welded are Heated by Oxy-acetylene Flames to a Temperature of About 2100 Degrees F. and Pushed together to Effect the Welding

unit pressures as high as 5000 pounds per square inch. Welds can be made with pressures as low as 1000 pounds per square inch, but upsetting is slow at this comparatively low pressure, and surface melting results.

In order to insure uniform and controlled local heating, it is necessary that the heat supply be proportioned to the dimensions of the work cross-section, so that the rate of temperature rise will be uniform throughout the section. The interior of sections must be brought to the welding temperature without overheating the external surfaces.

For practical purposes, requirements of uniform and controlled heating are best met by employing a multiple number of small oxy-acetylene flames. This method of heating provides a wide latitude in balancing the local heat input with the heat requirements at any particular point. In practically every application, the heating flames are directed against the outside of the work only, an exception being made in some cases of very heavy walled tubing. In such instances, the application of heat both on the inside and outside of the tubing may be resorted to.

In most pressure-welding operations, it is desirable to keep the blowpipe in motion with respect to the work, or vice versa. In the case of cylindrical parts, it may be more convenient to rotate the work and hold the blowpipe stationary. However, the welding head may be given a slight circumferential oscillation and the work held stationary. By moving the welding

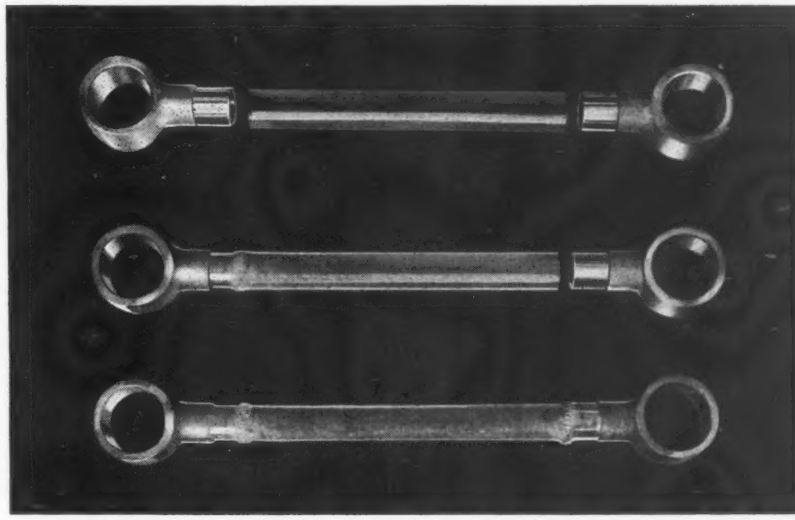


Fig. 2. Successive Stages in the Pressure Welding of Steel Tubes and Forged Eyes to Fabricate Torque-tube Axles for Truck and Tank Bogies

head longitudinally back and forth across the interface, it is possible to heat the desired width of zone with a blowpipe of smaller dimensions and simpler construction than would be required if the entire width of the heated zone were covered with stationary welding flames.

Moving the blowpipes or the work also permits the use of greater capacity heating flames, with a consequent economy in welding cost due to the reduction in time required for welding and reduced loss of heat by conduction. One instance in which the movement of the flames is especially advantageous is in the welding of rail steel. This high-carbon high-manganese material is very susceptible to "burning." In rail welding operations, therefore, the blowpipes are moved to and fro sufficiently to prevent the formation of a spot or zone of "burned" metal under the heating flames.

Pressure welding is suited for operations in which the opposing work faces are practically the same in size and shape. In pressure welding

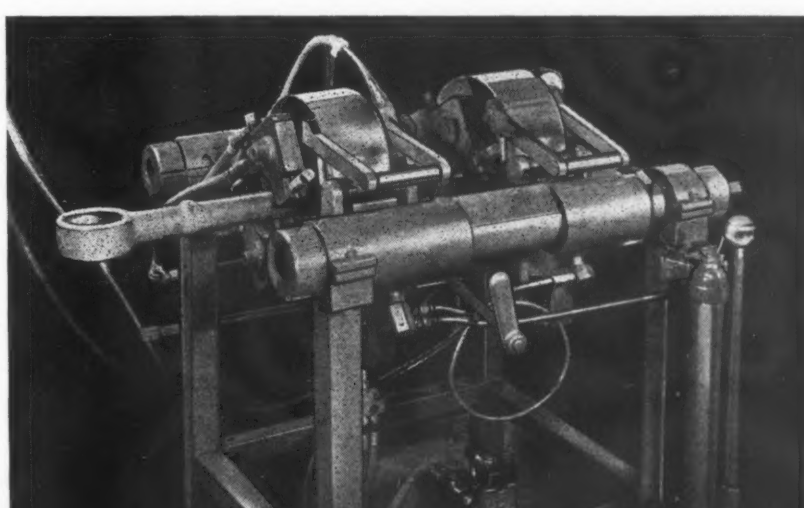


Fig. 3. Machine Designed for Welding Tubes and Eye Forgings together in the Fabrication of Torque-tube Axles

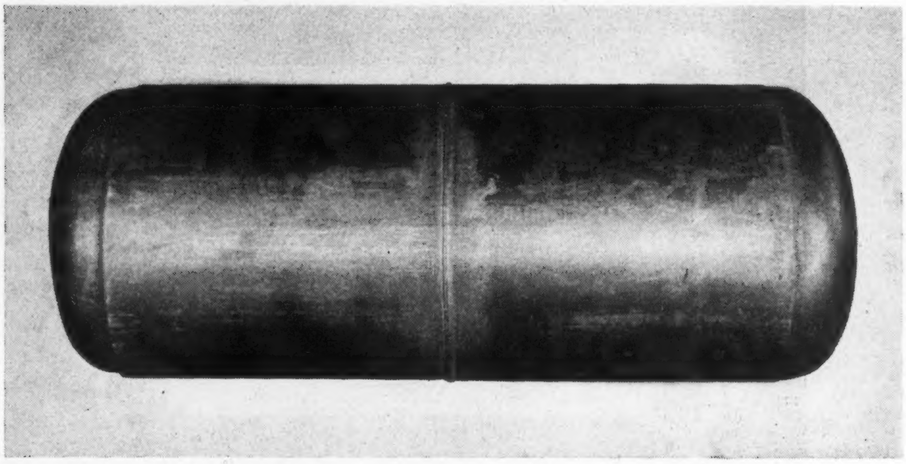


Fig. 4. Cylinders for the Shipment of Liquefied Gases are Constructed by Pressure Welding together Two Deep-drawn Shells 12 Inches Outside Diameter

members of different thicknesses, the larger section is tapered to the same dimensions as the smaller section, so as to provide equal thickness at the joint. The most important point to consider in regard to the shape being welded is whether it can be adequately heated by a series of oxy-acetylene flames without interfering with the application of pressure.

Two techniques that differ only mechanically have been developed for controlling the process. In one, the work ends to be welded are machined to a fairly smooth, clean finish. The necessary quality of end preparation depends primarily upon the composition of the base metals to be welded. For average low-carbon steels, the principal requirement is cleanliness, as very satisfactory welds have been made on a production basis with a rather rough finish. With high-carbon steels, and more particularly alloy steels, close mating, as well as cleanliness, is essential.

The work faces are usually cleaned first with a grease solvent. The parts are then loaded into the machine, which aligns the faces and forces them together under an initial load of approximately 3000 pounds per square inch of cross-sectional area. The blowpipes are next lighted (having been previously adjusted to predetermined gas pressures), after which their reciprocation across the interface is started. When a temperature of about 2000 degrees F. is reached, the metal starts gradually to upset. The process continues with the temperature of the work increasing gradually to a value of about 2300 degrees F., during which time the predetermined amount of upset is obtained and the flames are extinguished. Pressure is maintained until the weld has cooled somewhat.

In the alternate pressure-welding technique, which is widely used, the only differences are that an initial low pressure is applied to the work-pieces during the heating period, and upsetting is accomplished by rapidly increasing the hydraulic pressure after a certain time interval, or when a predetermined temperature of the work has been attained.

The amount of shortening in the work-pieces, or the amount of upsetting of the metal at the joint, represents, under the condition of constant heat input, an integration of the elements of time, pressure, and average work temperature. It has been found that the amount of upset or shortening of the work-pieces is an entirely satisfactory measure of the progress of the weld, when pressure is properly controlled. The amount of upsetting is rather difficult to measure, because upsetting occurs immediately under the flames. For this reason, the amount of shortening of the work-pieces is generally used as an index of the progress of the operation. This method of determining when a weld has been completed gives a further advantage in that electrical or mechanical means can be set up to shut off the gases and the pressure when a weld has been consummated.

Pressure welding is free from two elements that limit the applicability of fusion welding to some metals—namely, the element of fusion and the presence of added weld metal. The molten condition would seem to be the ideal state in which to unite two metal parts, but fusion frequently offsets this apparent advantage by seriously impairing the quality of the base metal through overheating, burning, or other high-temperature reactions.

Medium-carbon, high-carbon, and alloy steels are especially sensitive to these high temperature effects. Most of these reactions, such as the burning of high-carbon steel, occur only at, or close to, the solidus temperature. Since in pressure welding the temperature within the cross-section being welded need not exceed 2250 degrees F., the base metal is not subject to the detrimental effects of fusion temperatures. It is for this reason that high-carbon and alloy steels can be pressure welded with welds having physical properties equivalent to those of the original base metals.

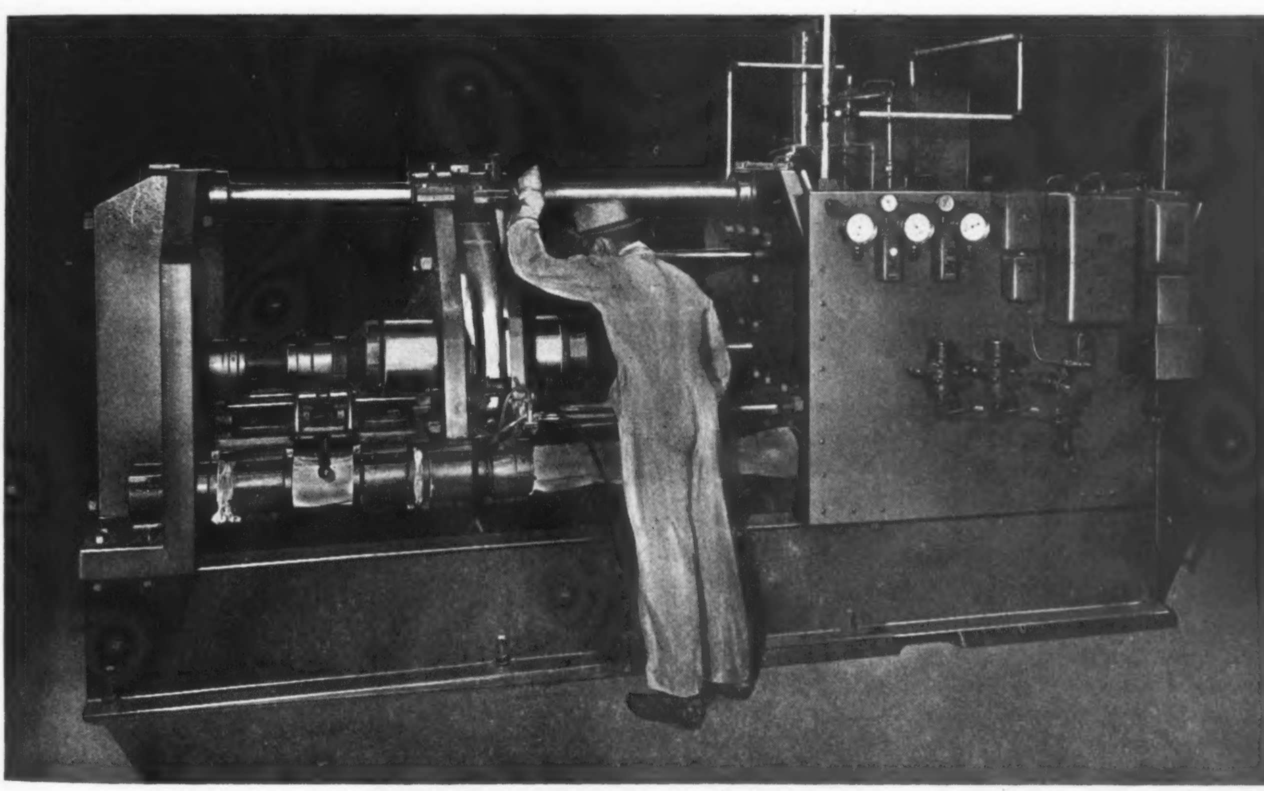
The physical properties of pressure-welded parts are dependent only on the properties of the original component metals. The welding temperature modifies the original physical properties by hardening, or some similar action, but the original properties can be restored by suitable heat-treatment.

Some of the higher carbon steels and medium alloy steels should be normalized to refine the grain structure produced during pressure welding and to obtain a better balance between tensile strength and ductility. Torch-normalizing serves as an effective means of producing the desired improvement. This can be done with the same set of oxy-acetylene blowpipes with which the welding was accomplished, the gas pressures and the heating time being adjusted to obtain the normalizing temperature throughout the work section without local overheating.

The general metallurgy of pressure-welded joints appears relatively simple. Except for the metallographic changes caused by heating through the critical temperatures, there is very little indication of the presence of a weld.

While the most extensive application of oxy-acetylene pressure welding has been in the joining of railway rails and overland pipe lines, the process is finding increasing application in factory production. One such important application is the welding together of two members of a landing gear strut for large cargo airplanes. In this operation, a tube 6 1/8 inches outside diameter, with a wall thickness of 5/16 inch, is joined to the end of a forging having an extension of similar dimensions.

Fig. 5. General View of the Special Machine Designed for the Pressure-welding Operation on Liquefied Gas Cylinders



This landing gear strut is welded in a vertical hydraulic press specially designed for the operation. The tube is supported in a fixture in the lower portion of the press, and the forging is attached to the overhead platen. A circular heating head which surrounds the joint between the two parts directs the oxy-acetylene flames to the area to be heated. Prior to the adoption of pressure welding in this shop, the entire structure, which now consists of a forging and tube, was necessarily a complicated one-piece forging.

Torque-tube axles for truck and tank bogies are made up by pressure welding a length of steel tubing and two forged eyes. The stages of this operation are indicated in Fig. 2, which shows at the top the three parts that are pressure welded together. In the center are shown the same parts after one eye has been welded to the tube, and at the bottom, the completed assembly.

The tube measures 1 3/4 inches inside diameter, has a wall thickness of 1/4 inch, and is 16 inches long. The eye shanks are machined to the same diameters and are turned for a distance of 1 1/2 inches to insure uniform welding. The machine used for this operation is shown in Fig. 3. It will be seen that the work-holding jaws are mounted on heavy horizontal bars. The jaw at the left, which holds the tube, remains stationary during the operation, while the jaw at the right, which holds the eye, is movable to and from the tube-holding jaw.

Cylinders of the type seen in Fig. 4, which are used for the shipment of liquefied gases, are pressure welded with the equipment illustrated in Fig. 5. These cylinders are built up from two deep-drawn shells, which are about 12 inches outside diameter and have a wall only 1/8 inch thick. In the operation, the welding head is oscillated manually through a short amplitude to insure uniform heating of the shells.

Hydraulic pressure pushes the drawn shell at the right against the firmly held shell at the left. The floor-to-floor time for this operation is only 30 seconds.

Core-drill, planer tool, and chisel tips of high-speed steel are pressure welded to shanks of low-carbon steel in a large fabricating plant. The core drills are of the construction seen at the extreme right in Fig. 6 when finished. They are used in drilling armor plate to obtain metal chips for chemical analyses and a core for the testing of physical characteristics of armor plate. The finished drills have an outside cutting diameter of 2 1/2 inches and are 16 inches long. The rough welded stock, which is shown as the second example from the left, is 2 5/8 inches outside diameter by 16 1/2 inches long. The high-speed steel tip is about 2 inches in length.

At the extreme left is seen a high-speed steel tip for one of these tools resting on the low-carbon steel shank. In the pressure-welding operation, the shank is first placed on the upward moving bottom platen of a press, and then the tip is laid on the shank, as shown in Fig. 7. After the tip has been positioned on the shank, a pressure of about 1000 pounds per square inch is applied to raise the platen and bring the tip against a plug on the stationary overhead casting of the machine, as illustrated in Fig. 8.

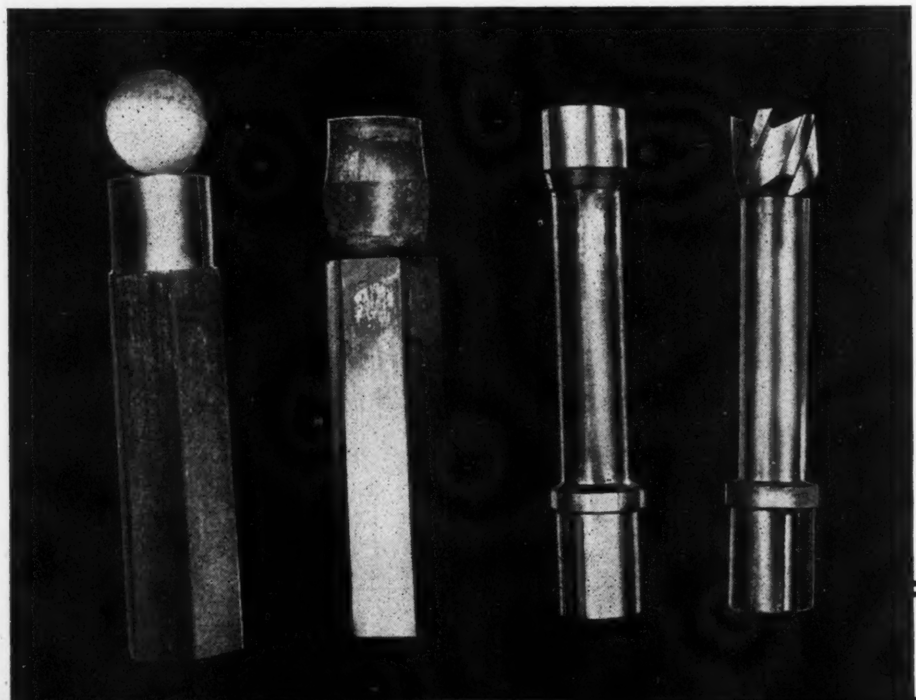


Fig. 6. Successive Stages in the Making of Core Drills which Consist of a Piece of High-speed Steel Pressure Welded to a Shank of Low-carbon Steel

A lever is next operated to trip a valve that controls the supply of oxygen and acetylene, the oxy-acetylene heating head being automatically lighted by a pilot flame. The lever also trips two timing devices and causes power to be applied to a mechanism for reciprocating the flame head with a stroke 2 1/2 inches in length. After a lapse of five minutes thirty seconds, one of the timers causes the full pressure of 4000 pounds per square inch to be applied on the heated abutting faces of the drill tip and shank. This is accomplished by tripping a solenoid valve, which applies air pressure to an air-operated booster.

The time of upsetting, which starts right after the application of heavy pressure, lasts for about one minute. When upsetting has been completed, the operator again moves the control lever to turn off the gases, release the pressure, and permit the bottom platen to drop into its lower position. These core-drill blanks are annealed before machining and are hardened after machining. It is claimed that drills made by this method produce from twelve to fifteen holes in armor plate, as against three to four holes with the ordinary core-drills previously used.

The procedure followed in welding the core drills is also employed in welding the high-speed steel tips to the shanks of large planer tools and chisels. However, the timing of the machine is adjusted to suit these operations.

Oxy-acetylene pressure welding, as indicated by the examples here presented, is a commercially practical method of welding metals at sub-fusion temperatures under controlled temperature and pressure. With this process, the entire joint between two pieces of work is welded simultaneously. Generally speaking, the total gas consumption in pressure welding is considerably less than the consumption in fusion welding. For these and other reasons, the cost of pressure welding compares favorably with that of other methods of mechanized production welding.

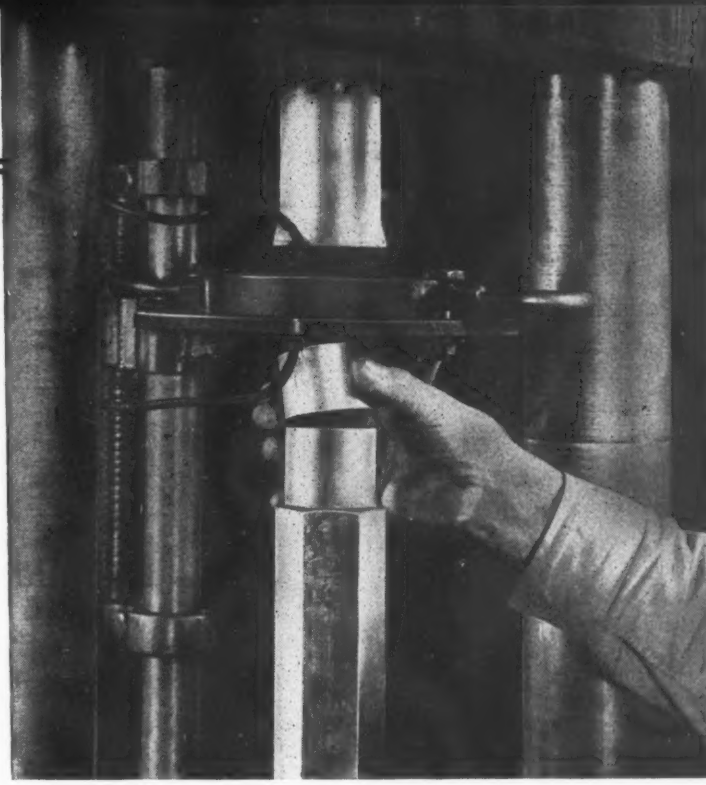
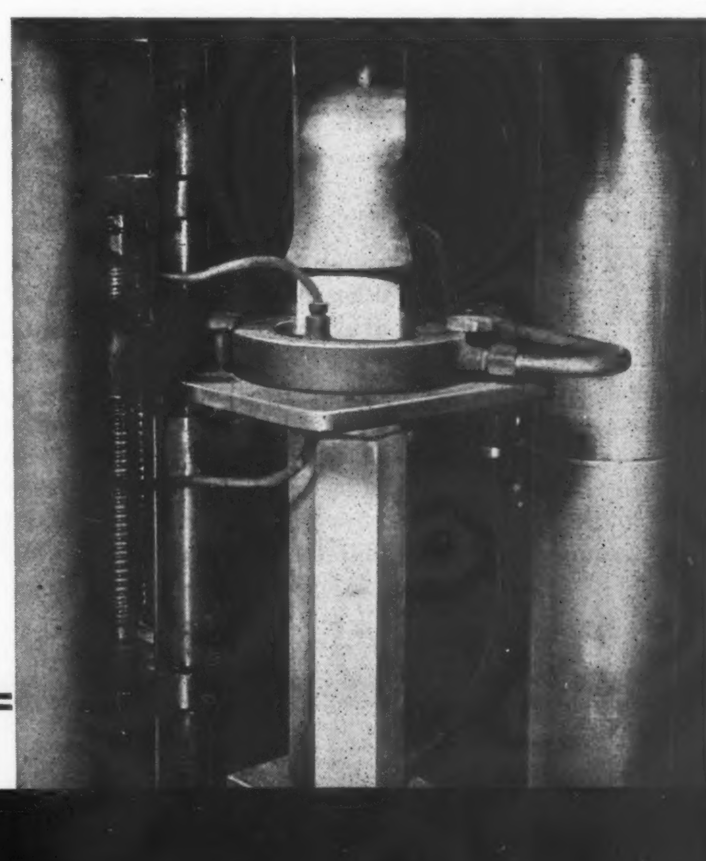
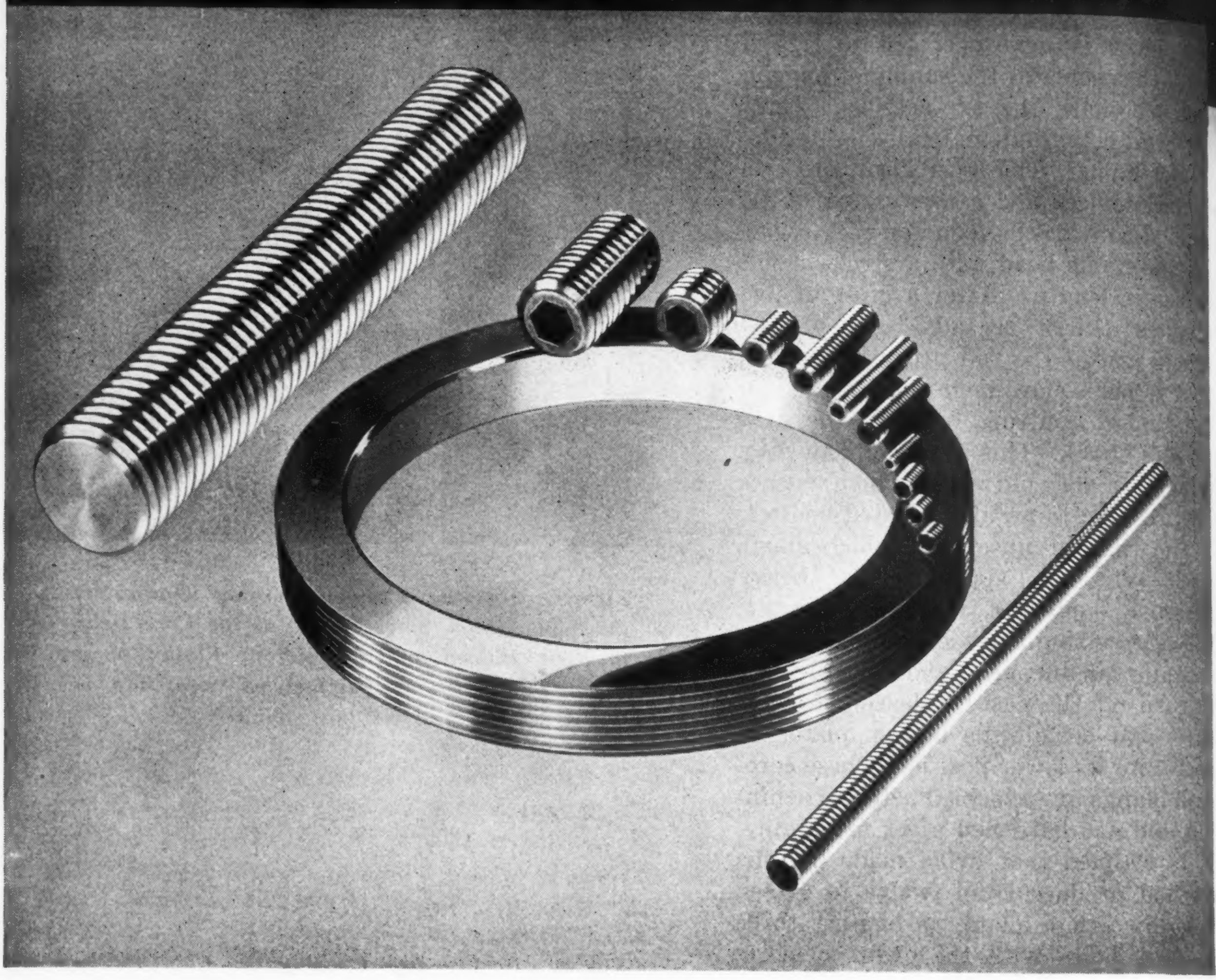


Fig. 7. For the Pressure-welding Operation the Low-carbon Steel Shank of the Core Drill is First Placed on the Bottom Platen of a Press, and Then the High-speed Steel Tip is Laid on the Shank

Fig. 8. In Pressure Welding the Core Drills, the Platen is Raised under Pressure to Bring the High-speed Steel Tip against a Plug on an Overhead Stationary Member of the Press



Centerless Grinding



When Centerless Grinding of Plain Cylindrical Surfaces was First Introduced, the Process was Looked upon as Revolutionary in Shop Practice—Now Screw Threads are being Ground Commercially by the Centerless Method on Equipment Developed by the Landis Tool Co.

WHEN centerless grinding of cylindrical surfaces was first introduced, mechanical men marveled at this new development. In the course of two or three decades it has become a commercial process of the greatest importance in the manufacturing industries.

Now another epoch-making step has been taken in the further development of the centerless grinding process. Screw threads are now being ground from the solid on a commercial basis at speeds and with an accuracy not previously attained in the commercial cutting of similar threads. The method has been successfully applied on a commercial scale to the grinding of hardened socket set-screws from 1/8 inch to 5/8 inch in diameter, with pitches from 40 threads per inch to 11 threads per inch. Thread diameters up to 5 inches are also being ground, and thread lengths up to 12 inches have been successfully handled. The heading illustration

# of Screw Threads . . . . A Revolutionary Development

shows various types of work threaded on the newly developed Landis Tool Co.'s centerless grinding machine.

Accuracy Obtained in Centerless Thread Grinding

In examining commercial set-screws in which the threads have been ground on a production basis by the centerless method, the following facts have been established:

1. The error in lead can be held to 0.0005 inch in 1 inch. This error can be reduced if the production rate is reduced, because if the screws are passed by the grinding wheel at a slower speed, the lead error is reduced. In tests, screws have been ground with a lead error of not more than 0.0001 inch per inch. The pitch diameter can be held to within 0.0002 or 0.0003 inch of basic pitch diameter.

2. In all cases where the outside diameter of the screw is ground throughout the length of the screw, the pitch diameter has been found to be constant, as well as concentric with the outside diameter.

3. The sides of the threads are remarkably smooth and straight.

4. The angle of the thread is as accurate as the angle of the grooves in the "crusher" used for dressing the thread grinding wheel, and can therefore be held accurately to 60 degrees.

Production Attainable by Centerless Thread Grinding

Centerless thread grinding has been applied for about a year to the grinding of threads on commercial socket set-screws. These screws are ground to a finished size from a hardened solid screw blank in one pass through the machine. Figures available on the grinding of 1/4–20 screws give an idea of the production possible. An economical rate of grinding this size of screw is from about 30 to 35 inches in length per minute. This means that if the blanks are 1/2 inch in length, they are ground at the rate of from 60 to 70 per minute. It has been found possible on many occasions in grinding 1/4-inch diameter screws, in everyday performance, to operate continuously for eight hours without redressing (recrushing) the grinding wheel.

Screws are inspected and measured while the machine operates, so that any further inspection is unnecessary. The only difference between the first and the last screws passing through the machine is in the root diameter. Initially, the root of the thread must be narrow, and the root diameter must be near the permissible minimum. Gradually, as the threads on the grinding wheel wear, the root of the thread will be broader and the root diameter of the screw will be near the permissible maximum. In both cases, the root will be rounded, as the crests of the ridges on the grinding wheels do not retain sharp edges for any length of time. Generally speaking, in the production of socket set-screws it has been possible to grind threads by the centerless method at a rate approximately five times that usual for cut threads, and at a cost for the threading operation correspondingly reduced.

Principles of Centerless Thread Grinding

The essential elements of a centerless thread grinder are the same as those of a regular centerless grinding machine; that is, there is a grinding wheel, a regulating or feeding wheel, and a work-rest. The machine must permit adjustments to take care of work of different sizes, allow different rates of feed through the machine, and must have means for properly placing and supporting the work with respect to the grinding wheel.

As shown at *A* in Fig. 1, the grinding wheel may be moved laterally to increase or decrease the space between the grinding wheel and the regulating wheel. Movements of the grinding wheel as small as 0.0001 inch can be made by means of a handwheel. The regulating wheel and its base have universal movements, as shown by the arrows in Fig. 1. This wheel can be moved laterally, as indicated at *A*, to increase

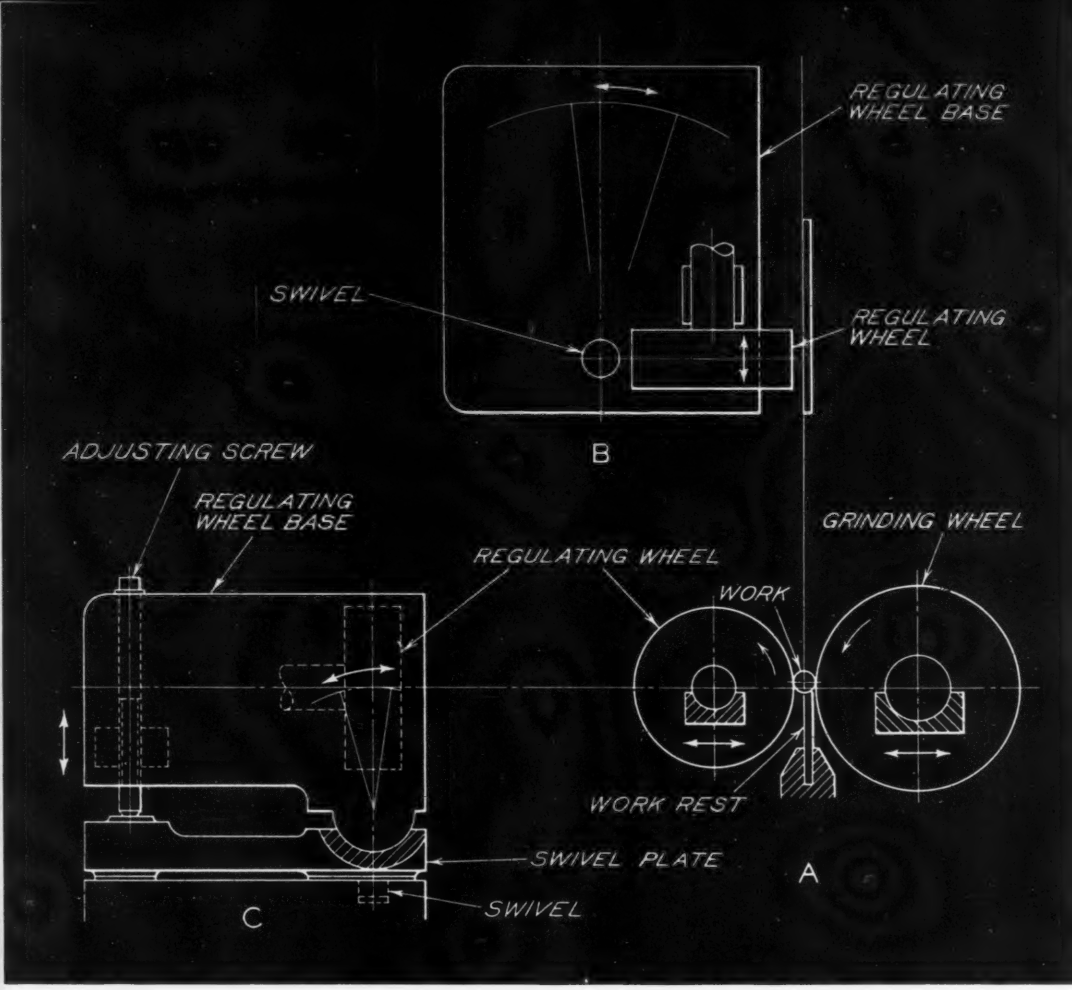
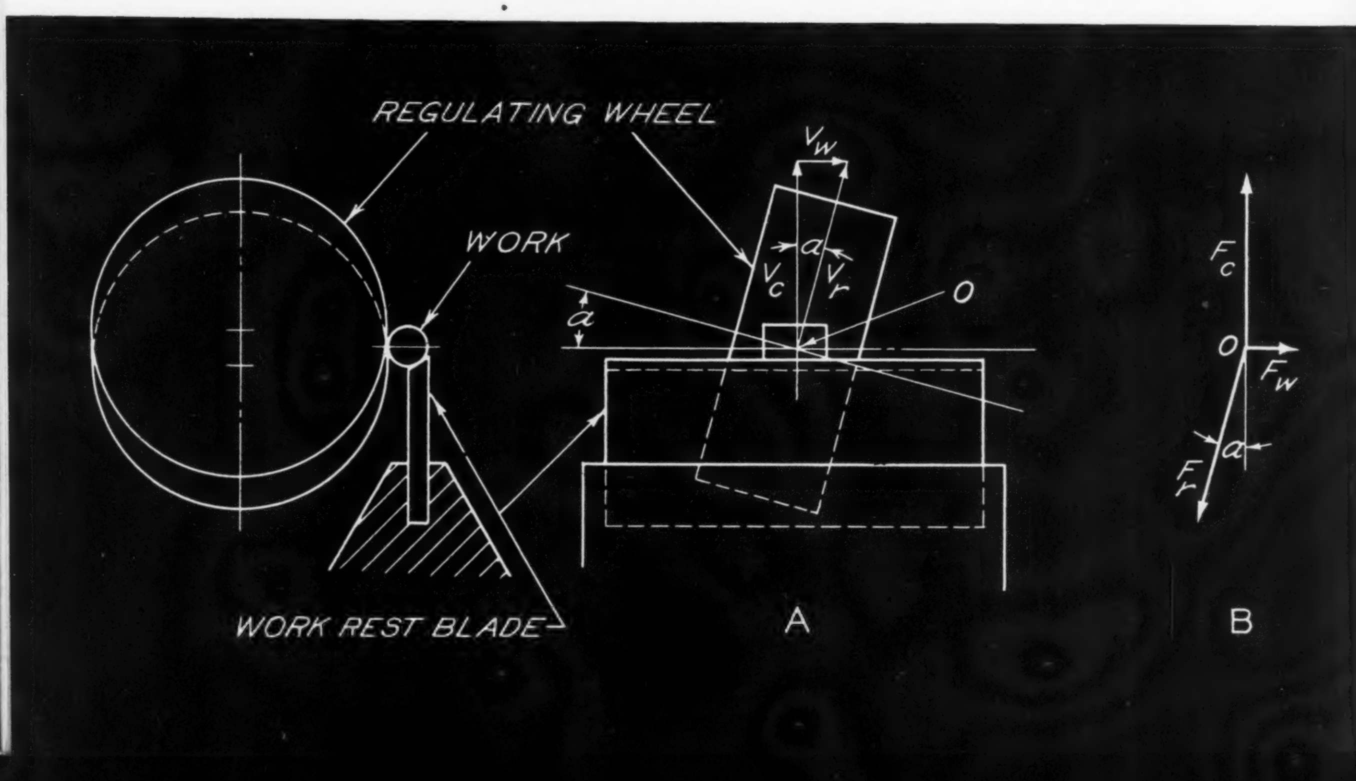


Fig. 1. Diagrammatic View Showing Relation of Grinding Wheel, Regulating Wheel, Work, and Work-rest, and the Adjustments Available

or decrease the distance or "throat" between the wheels and to locate the regulating wheel as required for different diameters of work with respect to the stationary work-rest. This wheel can also be adjusted back and forth, as shown at *B*, and in addition, has a traverse movement to enable it to be diamond-dressed on the exact line of contact with the work.

A swivel plate, as shown at *C*, permits rotation of the regulating wheel base to adjust the

Fig. 2. Analysis of the Feeding Acti on in a Centerless Grinding Machine

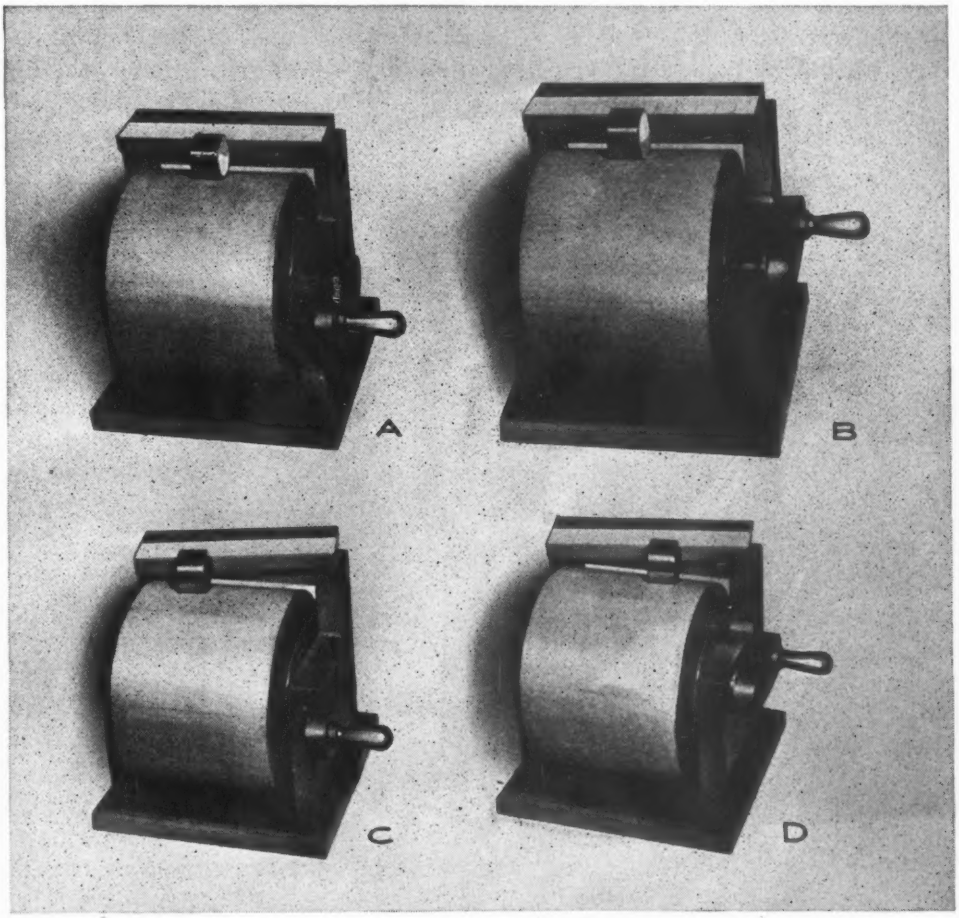


wheel parallel to the grinding wheel or at any angle. Another adjustment—perhaps the one most frequently used—is also indicated at *C*. The entire regulating wheel base can be tilted to the required angle to provide the feeding action through the throat between the grinding wheel and the regulating wheel. The adjusting screw is graduated so that the angle can be adjusted to the nearest minute of a degree.

Fig. 3 illustrates a model that demonstrates the feeding action of the regulating wheel. At *A* and *B* the blade at the top is shown parallel with the axis of rotation of the regulating wheel. If the wheel is rotated one-half a revolution, as indicated at *B*, the work represented by the small roller does not move axially. However, when the blade at the top is placed at an angle to the regulating wheel axis, as at *C* and *D*, one-half revolution of the wheel, as at *D*, produces an axial movement of the work as shown.

Those interested in the mathematical theory involved may wish to refer to Fig. 2. Here let V_r represent the peripheral velocity of a point O on the regulating wheel. This velocity is equal to the circumference of the regulating wheel times the number of revolutions it makes per minute. The angle a is the tilt angle. Then the vector V_w represents the axial speed of the work across the face of the regulating wheel. The velocity V_w is equal to the velocity V_r times the sine of angle a. The vector V_c represents the peripheral velocity of the point O on the work. The velocity V_c is equal to the velocity V_r times the cosine of angle a. A resolution of the forces involved is shown at *B*. Here the tangential breaking force F_r of the point O on the regulating wheel is the resultant of the forces F_c and F_w. The force F_c represents the tangential force at the point O on the surface of the work, and F_w represents the force producing an axial

Fig. 3. Model Used to Demonstrate the Principle Involved in the Feeding Action of the Centerless Grinding Machine



movement of the work. The angle a represents the helix angle of the screw thread being ground, and is the angle between the path of the center of the screw and the axis of the regulating wheel spindle.

The Centerless Thread Grinding Machine

The adaptation of the No. 12 centerless grinding machine built by the Landis Tool Co., Waynesboro, Pa., to thread grinding involved some changes in its design. Fig. 4 shows the new Landis Tool Co.'s thread grinder. First of all, a dressing or crusher attachment had to be built into the grinding wheel base and a motor drive provided for it. This attachment is used in addition to the hydraulically operated diamond dresser for the grinding wheel that is embodied in the regular centerless grinding machine. Then, an auxiliary speed reduction had to be provided for the regulating wheel, so that its rotative speed could be further reduced. A new type of work-rest has been designed to meet the special requirements of thread grinding, and finally, electrical controls have been provided to assure flexibility of operation.

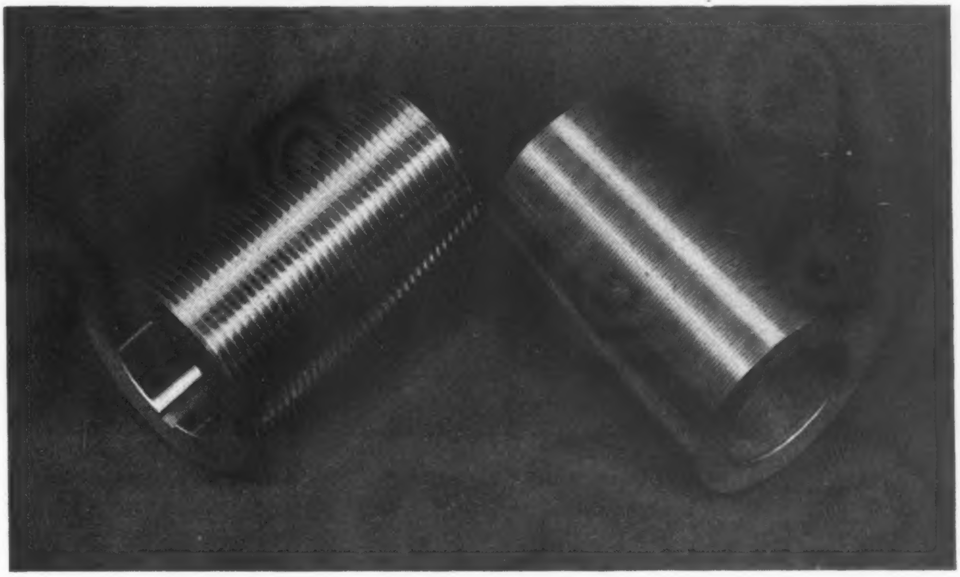
The crushing attachment houses the crusher, by which the desired form or profile is rolled into the face of the grinding wheel. A handwheel with a graduated rim provides means for forcing the crusher a definite amount against the grinding wheel face. The crusher is a hardened steel cylinder provided with annular grooves corresponding to the thread to be ground. It is so mounted that it can be easily removed and replaced by a new crusher. Two crusher rolls are shown in Fig. 5. The one with the coarser grooves is for a 1-inch diameter screw having 8 threads per inch, and the other is for a 3/8-inch diameter screw having 16 threads per inch. The crusher is driven during the crushing operation instead of the grinding wheel.

The Crushing Operation

The experience gained thus far with the centerless thread grinding machine indicates that a crusher surface speed of approximately 150 feet per minute is satisfactory for crushing a 4-inch wide grinding wheel. The crusher life depends on this speed. The wear of the crusher roll and the deterioration of the thread form in the crusher are due to the honing action of the grinding wheel grit. Hence, the higher the sur-

Fig. 4. Machine for Centerless Thread Grinding Developed by the Landis Tool Co.

Fig. 5. Crusher Rolls Used for Forming and Dressing the Grinding Wheel for Centerless Thread Grinding



face speed of the crusher, the more rapid and severe will be this honing action.

In general, it takes about one minute of crushing to remove 0.001 inch from the radius of the grinding wheel. Thus, if the groove form on the face of the wheel requires renewal, and if 0.004 inch must be removed in the radial direction, the time required will be approximately four minutes. Usually, an additional minute is allowed, during which time the crusher is not fed against the wheel. This "drifting" of the grinding wheel permits a sharpening of the wheel form on the grinding wheel face as the pressure due to crushing is gradually relieved. In grinding some sizes of screws, it has been possible to use the wheel for a whole day or longer before recrushing the wheel to renew the thread form became necessary. The total idle machine time required to recrush a wheel is from ten to twelve minutes.

The diamond dressing attachment for the grinding wheel is used for truing the wheel before the grooves are crushed into it, and also for dressing a chamfer at the entrance edge of the wheel after the thread grooves have been crushed. This chamfering of the wheel is done for two purposes: First, for centerless grinding of the outside diameter of the blanks before the thread is ground; and second, for gradually forming the threads, so that the metal removal is distributed across the face of the wheel and the full-depth grooves mainly clean and true the thread form of the screw as it leaves the grinding wheel. The grinding wheel axis is at an angle with respect to the path of the screw equal to the helix angle of the thread of the screw.

The formation of the annular ridges on the grinding wheel by means of crushing is said to have three definite advantages: First, it saves time; second, the crusher can be used several times before being replaced; and third, the cost of the crusher is low, especially in terms of the production obtained.

The action of crushing is hard on the wheel, as well as on the crusher, and a grinding wheel with the right kind of bond is necessary. However, wheels are available that can readily be formed by crushing and that will retain the strength of the wheel structure necessary to maintain the required groove form.

Experience indicates that the wheel form has a shorter life immediately after the initial crushing from a solid wheel than after being recrushed later. In terms of the number of screws ground before renewal of the groove form is required, the production may be only about 2000 screws. A second crushing of the wheel, removing about 0.003 or 0.004 inch from the radius of the wheel with less crushing pressure, because it is now necessary only to improve the groove form, permits some 6000 screws to be ground before recrushing. Following the third crushing, with approximately the same amount of removal from the wheel, the production will rise to about 12,000 screws; and sometimes production runs of up to 14,000 screws have been ob-

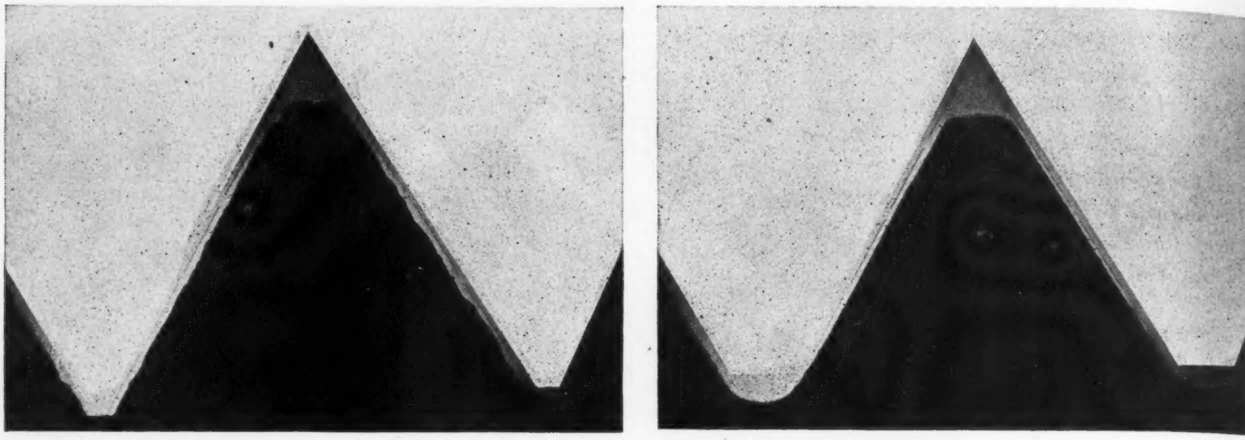


Fig. 6. Commercial Threads on Set-screws Selected at Random. View to the Left Shows a Cut Thread; View to the Right, a Ground Thread

tained before a renewal of the wheel form became necessary.

This experience has led to the belief that the life of the thread form on the wheel varies inversely with the length of time of the crushing operation—that is, the longer the crushing action is applied, the weaker becomes the wheel structure adjacent to the surface. This condition is particularly evident when the grinding wheel is constructed of the finer grits—say of 220 grit or finer.

The grooves on the grinding wheel for a particular pitch of thread are seldom dressed off the face of the wheel as long as it remains on the wheel center or arbor. Therefore, a grinding wheel that has been grooved should be kept on its wheel center when removed from the machine, and another wheel on a new center should be mounted in the machine when a different pitch of screw is to be ground. In this way, considerably greater over-all production or life per wheel is possible.

Effect of Grain Size of Wheels

It is obvious that the crest of the ridges on the grinding wheel for any given pitch is influenced by the size of the grain used in the wheel. For example, a thread crest 0.004 inch wide would be difficult to obtain on a grinding wheel having a grain size of 100, because the average dimensions of such a grain particle would be just a little less than 0.010 inch. For this reason, the grain size of the wheel must be selected on the basis of the number of threads per inch to be ground. In order to grind screws having the desired width at the root of the thread, the accompanying tentative table should be used.

Very soon after crushing, the form of the threads ground will have a root with a rounded bottom. On screw threads 1/4–20 and smaller, the rounded bottom becomes noticeable immediately after crushing. In view of the decided trend away from sharp corners at the root diameter of screw threads, the results obtained by centerless thread grinding are advantageous, and especially adapted to applications where fatigue strength of screws is involved.

An auxiliary speed reduction for the regulating wheel is provided which permits the rotative speed of this wheel to be as low as 2 R.P.M., whereas the minimum speed of the regulating wheel on the Landis Tool Co.'s No. 12 centerless grinding machine is 12 R.P.M. A clutch arrangement at the rear of the regulating wheel base permits changing from the standard speed range of 12 to 96 R.P.M. to the low speed range of 2 to 16 R.P.M.

Grain Size of Wheel Suitable for Given Pitches

No. of Threads per Inch	Wheel Grain Size	No. of Threads per Inch	Wheel Grain Size
40	400	18	220
32	320	16	180
28	320	13	150
24	320	11	150
20	220	..	...

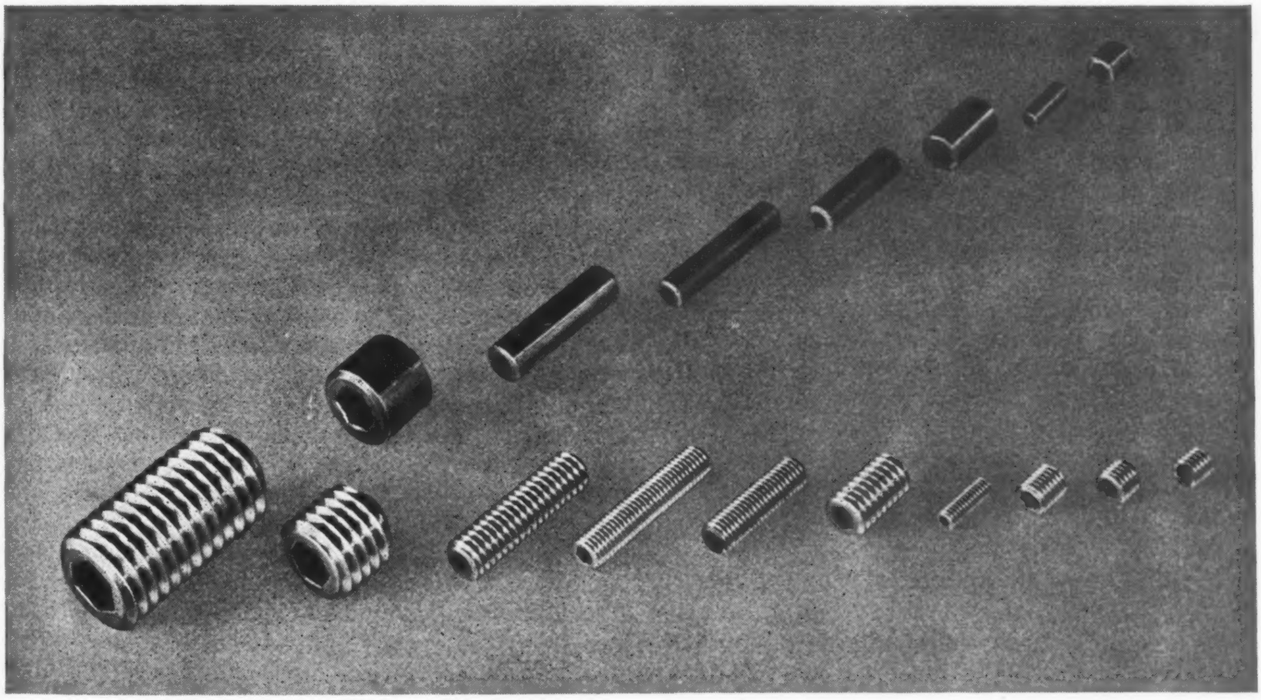
The work-rest requirements in centerless thread grinding are different from those of ordinary centerless grinding. The work-rest for the centerless thread grinder has side blades that move parallel to each other, so that the screw stock has a constant width of throat to pass through, no matter what the slope angle of the blade is. The time required to change the set-up for a different screw size and pitch has been materially reduced by providing wedges ground to the proper slope angle for each pitch of screw.

The electrical controls include a drum type switch having five stations: (1) Set-up station, when only the hydraulic pressure pump is in operation; (2) grinding station, when the grinding wheel, regulating wheel, and coolant pump are in operation; (3) dressing station, when the grinding wheel is in operation as before, the regulating wheel is running at a dressing speed of 300 R.P.M., and the coolant pump and the hydraulic pressure pump are running; (4) crushing station, when only the crusher drive motor and the coolant pump are running; and (5) regrinding station, when the crusher motor drive, the grinding wheel motor, and the coolant pump are running. Proper interlocking is provided to insure safety of operation in moving from one operating station to another.

In grinding socket set-screws with a cup point, it does not matter which end enters the machine first; nor does it matter if all the blanks line up with the same end first. Therefore, an automatic loader which will feed the blanks in line into the machine permits the operator to spend most of his time checking an occasional screw from one or more machines. Such checking on a visual shadow gage or with a ring gage will indicate whether the grinding wheel should be fed in slightly or whether the thread form on the wheel should be renewed by crushing. As long as the screw thread form meets the requirements of the class of fit desired, no change need be made.

A loader of the vibration type has been developed in connection with the machine described, which automatically feeds screw blanks 1/4 inch in diameter by 1/2 inch long at a rate as high as 85 per minute. The operator simply has to keep the hopper filled. Other types of loaders are available, and can be attached to the grinding machine as required.

Fig. 7. Socket Set-screws with Threads Ground from Solid Hardened Blanks on Centerless Grinding Machines



Incentive Wages in Post-War Years

INCENTIVE wage plans, honestly conceived and efficiently managed, present the best insurance for high wage payments, low-cost production, and permanent employment in post-war years. According to a comprehensive study made by Albert Ramond & Associates, engineers, there has been during the war, and more particularly since the wage stabilization order of October 3, 1942, a definite trend toward wider use of incentive wage plans. Several Government agencies have for the first time strongly endorsed the incentive principle.

A report issued in 1943, based on a survey made by the Department of Labor, shows substantial benefits from wage incentives in 659 plants. More recent reports of the Management Consultant Division of the War Production Board have shown an average increase in production of more than 40 per cent and average cost reductions of from 10 to 15 per cent due to incentive wage plans. The point of special interest to labor is that these recent incentive wage applications in several hundred plants have produced average wage increases of from 15 to 20 per cent, the wage increases having been proportionately greater than the reductions in cost.

The Ramond study points out that high productivity, low prices, and good wages are basic post-war necessities if American manufacturing plants and workers are to be fully occupied. However effective and valuable in wartime, the value of incentive wage plans will be even greater in peacetime.

The opposition to incentive wage plans has come largely from organized labor, and in some instances the opposition has been justifiable, because unfortunately there have been many instances where incentive wage plans have been abused by management. The fact, however, that there have been abuses in no way condemns a system of wage payment that is basically sound, since it rests on the wholly common-sense conception that wages should be proportionate to results. Several instances can be quoted where unusual annual wages are being earned because of a well planned and properly managed incentive payment plan. One of the outstanding examples is that of the Lincoln Electric Co.

Objections to Incentive Wage Plans

The reasons most commonly cited by labor officials in opposition to incentive wage plans are that incentive wages, by promoting increased production, may mean jobs for fewer men. At the present time, with the war man-power shortage, this argument has no weight, but it will reappear under more normal conditions. It is also argued that incentive wages, by increasing the total earnings, will have a tendency to hold down guaranteed hourly rates of pay, or at least to retard increases in hourly rates.

In addition to these objections are shortcomings that have been particularly present in some of the hastily improvised wartime plans. Some of these, despite the necessary War Labor Board approval, lack the essential requisites to make them of permanent benefit. In this category are those in which the standards of production were arrived at by guesswork or by past performance rather than through an adequate study of actual production possibilities. Lack of such study has given some incentive plans a "black eye" and made them unsatisfactory to both labor and management.

Then again, there are plans that were originally well designed, but have not been properly maintained and no longer fulfill the basic requirements that wages earned should be truly proportional to work performed, over and above a fair minimum standard.

High-Volume Production, Low Prices, and Full Employment Go Together

As against these objections, the important thing is to make clear to everybody concerned that the greatest insurance for continued employment and a high standard of living is a high volume of production. Only through high-volume production can we maintain the lowest possible prices, along with high purchasing power, so that all can share in the increasing capacity of industry to provide things that we all want for our well being and comfort. In other words, high production means low prices, and low prices mean the fullest possible employment.

As against the argument that incentive pay tends to depress the level of basic hourly wages, it is well known that the most efficient industries today (for example, the automobile industry) generally have the highest level of wages. Furthermore, most manufacturers realize that the important thing is not so much the amount of wages paid as the labor cost for each unit produced.

The automobile industry, for example, has paid much higher wages than the average for industry as a whole, and yet has had a labor cost per car so low that automobiles have been sold at prices that no one thought possible thirty years ago when wages, expressed in dollars and cents, were only one-half or one-third of what they are now.

"To insure continuance of the favorable trend toward the promotion and maintenance of incentives as a most desirable post-war influence for prosperity and full employment," says the bulletin by Albert Ramond & Associates referred to at the beginning of this article, "management must see that the plans are properly designed and maintained and that the workers are adequately informed about their advantages. Management must also arrange all possible protection for the workers."

* * *

Tool Engineering Education from the Industry's Point of View

In order to obtain a clear-cut picture of the opinions in industry with regard to the education of tool engineers, the American Society of Tool Engineers, through its committee on education and training, of which O. W. Winter is chairman, sent a questionnaire to leading industrialists and engineers—to the men who select and employ tool engineers. Over five hundred replies were received. A few of the questions and the answers received were as follows:

"Do you believe that the science of manufacturing has progressed to and reached a complexity and importance sufficient to warrant the recognition of tool engineering as a separate and distinct branch of the engineering profession?" Yes, 86 per cent.

"Do you consider tool engineering as a branch of mechanical engineering or industrial engineering, or as separate and distinct by itself?" Separate, 49 per cent; branch, 47 per cent; undecided, 4 per cent.

"Recognizing that tool engineering proficiency in the past has had to be acquired primarily by practical experience, do you believe that valuable time could be saved in the typical self-made careers of most tool engineers by the application of modern scientific teaching and training methods?" Yes, 93 per cent; no, 3 per cent; undecided, 4 per cent.

"If so, should tool engineering be taught in fully accredited engineering colleges giving engineering degrees or in technical institutes that lie in the educational plane somewhere between high school and college?" College, 51 per cent; technical institutes, 27 per cent; both, 22 per cent.

"Would you consider serving a regular apprenticeship in industry as a prerequisite to any tool engineering training?" Yes, 50 per cent; no, 42 per cent; undecided, 8 per cent.

"Would you consider graduation from a technical or trades high school a satisfactory substitute for a full industry apprentice term as a prerequisite to tool engineering training?" Yes, 44 per cent; no 50 per cent; undecided, 6 per cent.

"Do you favor, for tool engineering training, the cooperative system of education, where industrial experience and school training are combined in alternating periods?" Yes, 87 per cent; no, 9 per cent; undecided, 4 per cent.

"Do you think that four years spent in college, taking a qualified and basic course in tool engineering, would be time well invested? That is, could one learn more in college these four years than in industry?" Yes, 60 per cent; no, 24 per cent; undecided, 16 per cent.

"Would college training enable one to progress more rapidly in the first four or five years in industry after college with the result of a net gain in the total eight or nine years involved?" Yes, 88 per cent; no, 4 per cent; undecided, 8 per cent.

"Do you consider present college faculties competent to teach tool engineering subjects or do they need more actual experience themselves?" Not competent, 87 per cent; competent, 4 per cent; undecided, 9 per cent.

* * *

Machine Tool Industry Still Very Active

During the month of January—the last month for which complete statistics are available—the total net orders for machine tools (that is, new orders less cancellations) amounted to \$54,840,000, or at a rate of approximately \$650,000,000 a year. The total orders for the entire year of 1944, less cancellations, amounted to \$535,000,000.

The unfilled orders on hand at the end of January amounted to approximately \$275,000,000, while the total shipments for the month were \$37,500,000. At that rate of shipments, the unfilled orders represented a backlog of over seven months.

During October, November, and December, 1944, the net new orders varied from \$57,000,000 to \$60,000,000, or at an annual rate close to \$700,000,000. The unfilled orders rose from \$190,000,000 on September 30 to the \$275,000,000 mentioned at the end of January. Since September last year, shipments have amounted to from \$36,000,000 to \$37,500,000 monthly.

* * *

Index of Metals Literature

A complete subject and author index of all the metals literature published during the past year is being prepared by the library of the Battelle Institute, Columbus, Ohio, for the American Society for Metals. The index will be included in the bound volume of the "American Society for Metals Review of Metal Literature for 1944."

Air-Operated Gage for Checking Inside Diameter of Steel Tire Bases

AN inspection gage designed to save time and lessen worker fatigue in checking the inside diameters of steel tire bases is shown in the accompanying illustration. This air-operated gage is saving hours of heavy lifting, and has released two men for other jobs at the plant of the Dresser Manufacturing Division of Dresser Industries, Inc., New York City. This gage, suggested by an employe, was developed for checking the inside diameters of steel tire bases used on Army tank bogie wheels. Each tire base weighs 46 pounds, and formerly was lifted over a fixed gage by a service man stationed at the inspection bench, checked by a woman operator, then lifted off and moved to the next inspector by the service man.

The labor-saving gage now in use has completely eliminated the need for a service man on each shift. It consists essentially of a standard, circumferential tape type, measuring instrument or gage, mounted on a movable table that is raised and lowered at the work-bench by compressed air. Pieces ready for inspection are slid along the bench top to a stop, an air valve is opened, and the gage rises from below the table level to the proper position inside the tire base. The tire base is then inspected and the air pressure released to lower the gage, after which the inspector slides the piece along the table to the next station. If preferred, the gage can be arranged to be elevated by hand- or foot-levers.

Table Gage Raised from below Bench to Gaging Position Inside Work by Air Pressure

* * *

Technicolor Film on Arc Welding

A new technicolor sound motion picture entitled "Magic Wand of Industry—Arc Welding" has just been released by the Lincoln Electric Co. It portrays in a dramatic manner the spectacular progress of arc welding from the beginning to its present wartime role. The film was produced at the request of the U. S. Bureau of Mines, which is releasing the picture under the title "A Story of Arc Welding." It is a twenty-five-minute presentation, filmed under the direction of Lincoln welding engineers and staged and photographed in airplane factories, shipyards, steel mills, and other engineering undertakings like the Shasta Dam.

The film is primarily educational, and graphically presents the fundamentals of arc welding and the types of welded joints. Actual photographs of the electric arc were taken. In order to do this, it was necessary to use a battery of arc lights using lighting power equivalent to 4500 automobile headlights, all focussed on an area of 1 square foot.

The film is available in 16- and 35-millimeter prints to business groups, technical societies, schools and colleges, and industrial plants at no charge, except for transportation. It can be obtained on request to the Lincoln Electric Co., 12818 Coit Road, Cleveland 1, Ohio, or from the U. S. Bureau of Mines, Experimental Station, 4800 Forbes St., Pittsburgh, Pa.

* * *

Gear Demand Continues to Increase

The gearing industry, as represented by the members of the American Gear Manufacturers Association, with headquarters in the Empire Bldg., Pittsburgh 22, Pa., reports an increase in volume of sales for January, 1945—the last month for which complete statistics are available—as compared with December, 1944, of 47 per cent. This report does not include turbine or propulsion gearing.

Maximum Speeds for Grinding Wheels

WHEN grinding wheel manufacturers specify maximum speeds for the wheels that they make, the word "maximum" is frequently misunderstood or misused. It should be strongly emphasized that "maximum" does not mean "average," or "recommended," or "best." When applied to grinding wheel speeds, it means a speed that should not under any circumstances be exceeded.

The Grinding Wheel Manufacturers Association, through its Safety Committee, has pointed out the importance of recognizing this fact. It is surprising, the committee states, how many people apparently interpret the word maximum to mean the recommended speed under any and all conditions. This may be partly due to the popular opinion that the highest wheel speed is always the best. However, it should be remembered that, entirely aside from safety aspects, the best operating speed for many grinding operations may be considerably lower than the maximum.

Not only grinding machine users, but also grinding machine builders, according to the Safety Committee referred to, have misinterpreted the term "maximum." Grinding machine manufacturers often use high wheel speeds as a competitive sales point. According to the committee, the misinterpretation of the word "maximum" usually manifests itself in one of the three following forms:

1. The grinding machine manufacturer, assuming that a higher speed is always a better speed, or that the maximum speed listed is the recommended speed, establishes the speed of a new single-speed machine high enough so that the average surface speed during the life of the wheel will agree with the maximum speed listed. This, of course, means that the speed is too high when the wheels are new and of full size. The user, therefore, violates the maximum speed rule every time he mounts a new wheel.

2. Not recognizing that the maximum speeds listed for any broad class of wheels apply to the harder (stronger) grades only, the grinding machine manufacturer often establishes the speed of a machine too high for the grade of wheels required on the work for which the machine is intended.

3. There seems to be a common impression among grinding machine manufacturers that maximum speeds mean full-load speeds, and that there is no ceiling to the no-load speed. It is true that the listed maximum speeds are established with a sufficient factor of safety to allow for a small no-load over-speed, but in cases where the free speed is much higher than the full-load speed, there may be real danger of breakage when the wheel is running free. It should be remembered that the speed test used by the wheel maker is a no-load, free-speed test; hence, the factor of safety thus established may not be as high as is sometimes assumed.

It should not be inferred, however, that the machine builders are solely responsible for the lack of observance of the speed rules. The users sometimes take it upon themselves to increase the speed of a grinding machine in their plant without first consulting either the wheel maker or the machine builder. If the speeds of old machines are increased, it certainly is the part of wisdom to first determine if the machine bearings are of suitable design to operate at higher speeds, and if the design of the protective hoods are adequate to render real protection at high speeds. The changing of pulleys is not all that is necessary to convert an old low-speed machine into a *safe* high-speed grinder.

For each grinding operation there is usually a best or most efficient speed. Frequently, that speed is much less than the maximum, and may have to be determined by some experimentation and trial runs. To simply use the maximum permissible speed is a serious error.

* * *

Aircraft Jig Collimator

In the article "Checking Aircraft Assembling Jigs by Optical-Mechanical Means," published in January, 1945, MACHINERY, page 171, a collimator of British design was described. An aircraft jig collimator of American design is made by C. L. Berger & Sons, Inc., 37 Williams St., Roxbury, Boston 19, Mass., which serves the same purpose in lining up the jigs for plane assemblies. This jig collimator is an optical instrument of great accuracy, applicable in aircraft and shipbuilding, in general construction work, and in the tool-room.

* * *

Drop-Forging Die Manufacturers Join Tool and Die Association

A group of leading drop-forging die manufacturers recently decided to affiliate themselves with the National Tool and Die Manufacturers Association, having headquarters at 1413 Union Commerce Bldg., Cleveland 14, Ohio. Some drop-forging die shops have been members of the Tool and Die Manufacturers organization for some time, but the majority have not previously been affiliated with that group.

Removing Broken Tools from Drilled Holes

A METHOD for removing broken drills, reamers, plug gages, and other tools from drilled holes was developed some time ago by the production engineering department of the Pratt & Whitney Aircraft Division at East Hartford, Conn. This method consists of making an electric arc butt-weld between a stainless-steel welding rod and the broken part and then extracting the broken part by tapping with a hammer on a lathe dog or clamp secured to the welding rod. According to Henry J. Burnett, of the production engineering department, and Charles E. Hansling, of the salvage department, not only are more parts being saved from the scrap pile with this method, but the time required for the salvage operation has been greatly reduced.

Since at the Pratt & Whitney aircraft plant most of the parts from which broken tools are to be removed are made from aluminum or magnesium, the process was developed chiefly with these two metals in mind. When the method was first suggested, plugs of steel were driven into a magnesium test block having a number of holes of varying depths. This test block was used in the demonstrations to determine whether butt-welds of sufficient tensile strength could be made to extract the steel plugs. The percentage of successful extractions from the test block was sufficient to indicate the possibilities of this method if a proper technique could be developed.

In observing the action of alternating- and direct-current welding equipment, it appeared that less arc flashing occurred with an alternating-current welder than with a direct-current welder. This factor was important in that, as most of the work involves magnesium or aluminum castings or forgings, it is advisable to avoid excessive heating or splashing of hot metal, in order to preserve the heat-treatment of these metals in the area of broken drills and the quality of the finished surfaces.

It was found that the usual types of welding rod were not entirely suitable for this work. The best results were obtained when fluxed stainless-steel welding rods were used. The hard flux on the outside of the stainless-steel welding rods also serves effectively as an insulator, especially when a rod is being inserted in a drilled hole where the broken drill is several inches below the surface of the casting or forging.

In addition, a non-fuming compound for pro-

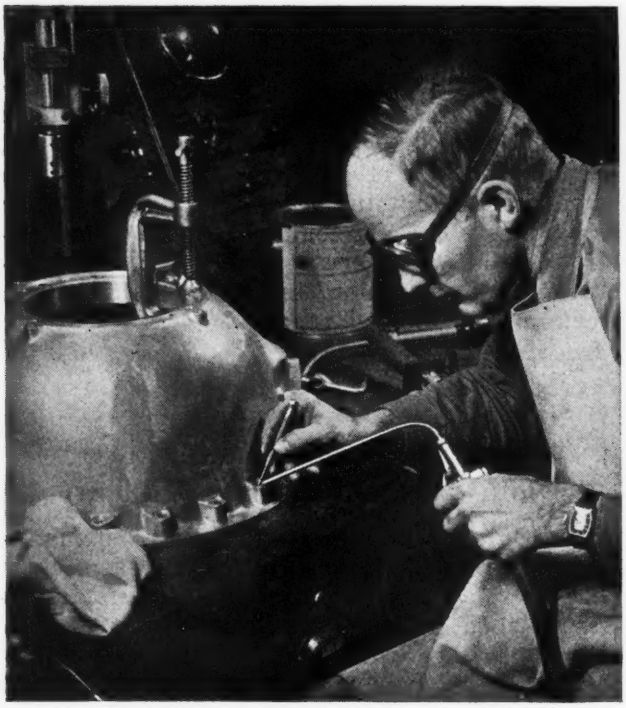


Fig. 1. Preparing an Engine Part for the Extraction of a Broken Drill

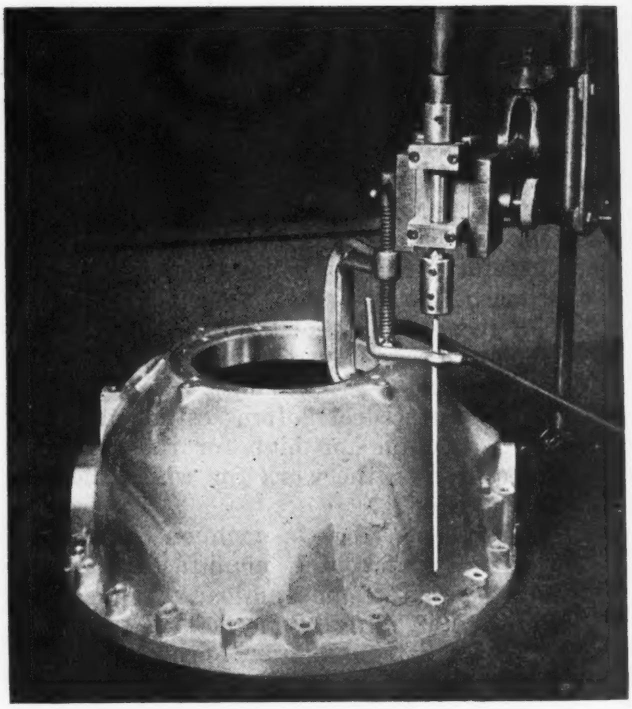


Fig. 2. Fixture for Holding Stainless-steel Welding Rod, with Rod in Place

tective purposes on finished surfaces, known as "Spatter-off," was employed. Having the consistency of medium lubricating grease, this compound can be spread easily in a light layer over any finished surface where protection from arc flashing is desired. When an arc flash occurs near the "Spatter-off," the heat of the arc immediately causes it to harden into a non-combustible protective crust. After the welding operation is completed and the broken part is extracted, this protective coating can be quickly removed, and by degreasing the part, the original bright quality of the finished surface is restored.

In specific cases, other forms of protection from the arc flash are used—for example, wet asbestos powder, fiber washers or bushings, and 1/4-inch brass plate drilled to fit over the opening of the drilled hole (especially when the broken drill is at the surface of the hole).

Fig. 1 shows an operator preparing an engine part for the extraction of a broken drill. By using a high-pressure air hose, the hole containing the broken drill is blown clear of all extraneous matter, such as metal chips, oil, dirt, and bits of shattered drill. A small prod carefully used often helps considerably in removing metal chips jammed into the area between the cutting edges of the broken drill. It is always good practice, particularly if the chips are aluminum or magnesium, to minimize the possibility of blow-back and unnecessary oxides in the vicinity of the welding surface due to the ignition of the chips at the moment the arc contact is made.

As proper cleaning prior to the welding operation usually pays dividends in labor saved, carbon tetrachloride also should be used to wash out any cutting oil or coolant films remaining in the vicinity of the broken tool. This is a very important feature of the cleaning process.

Fig. 2 further demonstrates the preparation of the part. Here the welding rod is already in the welding fixture, and the "Spatter-off" is applied to protect the finished surfaces of the part. In preparing the coated welding rod prior to inserting it in the welding fixture, it is good practice to round off the end of the rod on a grinding wheel to insure a good welding contact. Also, a dog should be tightened on the rod near the end that is to be inserted in the welding fixture, which can be tapped with a hammer after the weld is made, in order to extract the broken part.

The welding fixture shown serves a dual purpose. First, it guides the welding rod into the drilled hole in proper alignment with the center line of the broken drill. Second, after the weld is made, it serves to hold the rod steady while the hammer blows are being applied to the dog. It is particularly useful in extracting small broken parts where the diameter of the drilled

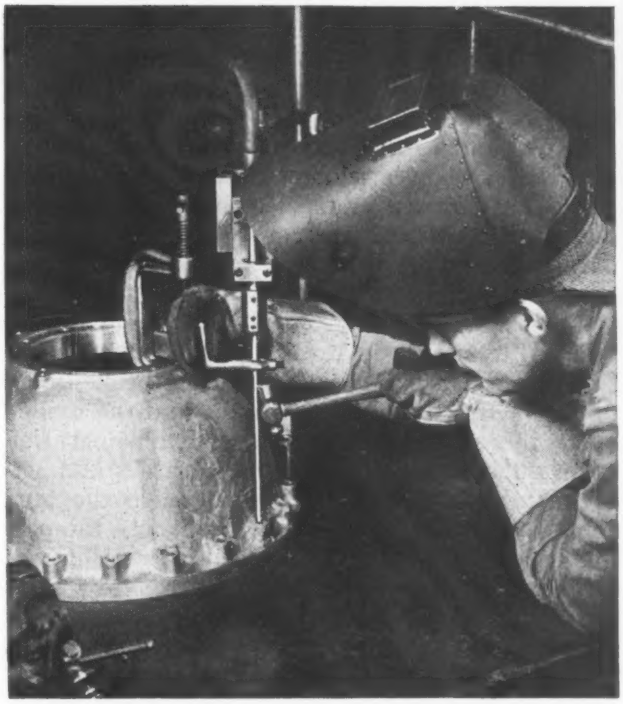


Fig. 3. Weld Completed, and Operator Tapping the Dog on the Welding Rod with a Hammer

hole is from, say, 0.040 inch to 1/8 inch. The welding fixture is supported by a modified heavy-duty lighting fixture, the tubing of which is replaced by solid shafting for greater rigidity. An arrangement of this sort is inexpensive and satisfactory when properly anchored to the bench.

In Fig. 3, the weld has been made and the operator is applying hammer blows to the dog. Broken drills when jammed tightly with chips, etc., respond to hammer impacts better than they do to a steady pull.

Sometimes crystallization occurs in the weld or blow-holes form due to the presence of cutting oil and various oxides, thus causing the weld to break under the hammer blows. In such cases, it is usually necessary to reinspect the point of contact of the stainless-steel welding rod, clean the chip oxides from the drilled hole, or readjust the ampere rating of the power supplied to the weld to better suit the size and material of the broken drill.

Frequently, however, it is discovered that the broken drill was shattered when it broke in the drilled hole. This necessitates several welding attempts before the solid part of the drill is reached. Experience shows that occasionally as many as five to ten attempts have to be made before the solid part of a drill can be removed. Also, the drill is often shattered when attempts are made to remove it by pounding the part or by trying to drive it out with a prick-punch.

The importance of having machine operators or set-up men make absolutely no attempts to

remove any broken tool from engine parts should be stressed. The usual crude method employed by an operator is to try to drive out, or break out, the broken tool, piece by piece, with a prick-punch and hammer. Experience shows that this method is seldom successful and usually results in burred surfaces and other forms of distortion that directly cause scrap or tend to defeat the purpose of the arc-welding method of removal.

The use of a prick-punch and hammer also frequently results in broken punch points being tightly lodged in the hole above the broken drill or jammed in between the flutes and the drilled hole, thereby making the removal operation more difficult or impossible. Operators and set-up men should immediately set aside the part containing the broken tool without any tampering whatsoever. By the method of welding, the time required for removal is only a few minutes, and the drilled hole does not require plugging and redrilling or any other form of repair.

Fig. 4 illustrates the extracting of a pilot that has been broken in a drilled hole of a cylinder pad. The same removal technique is used to extract this pilot as was employed in removing the broken drill. Note that "Spatter-off" protects the finished surfaces in and around the drilled hole.

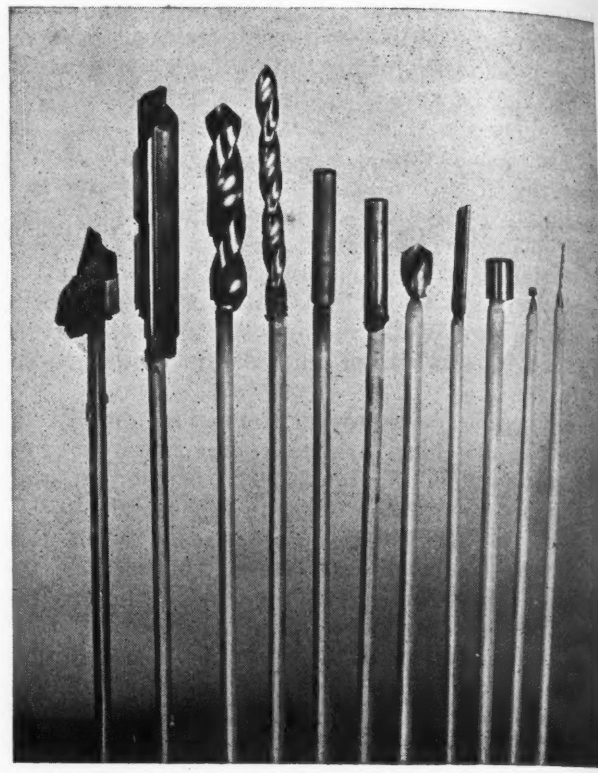


Fig. 5. Drills, Reamers, and Pilots that have been Removed by the Welding Method

The smallest size drill that has been removed by this method is a 0.040-inch drill in the bottom of a 5/16-inch hole, 3 inches deep, in an engine crankcase section. Previously the drill would have been removed by trepanning around it and inserting a plug of the crankcase material. This would have necessitated the redrilling of the 0.040-inch oil-hole in the production line. The trepanning, plugging, relocating in the fixture, and re-operating would have required several hours of labor.

Fig. 5 shows a variety of drills, reamers, and pilots removed by the method described.

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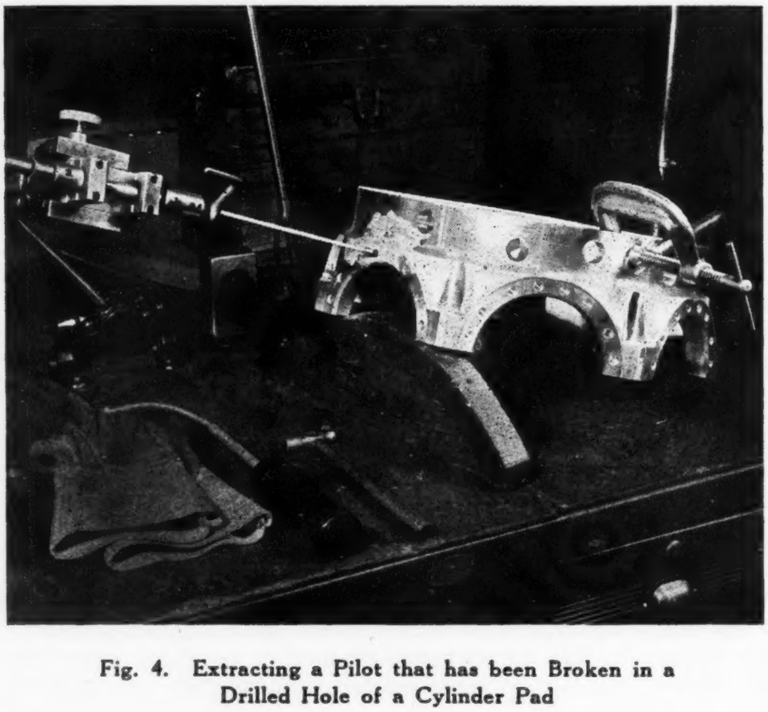


Fig. 4. Extracting a Pilot that has been Broken in a Drilled Hole of a Cylinder Pad

Simplified Practice Recommendation for Abrasive Grain Sizes

The proposed revision of the Simplified Practice Recommendation for Abrasive Grain Sizes, submitted to manufacturers, distributors, and users for approval, has been accorded the required degree of acceptance, and therefore will be published as Simplified Practice Recommendation No. R118-45, effective April 1.

The recommendation covers a simplified schedule of grain sizes for aluminum-oxide and silicon-carbide abrasives for polishing uses and for grinding wheel manufacture. Those interested can obtain mimeographed copies upon application to the Division of Simplified Practice, National Bureau of Standards, Washington 25, D. C.

Procedure in Making Magnesium Castings

IN a paper read before the American Society of Tool Engineers, Carl J. Wiberg of the Wright Aeronautical Corporation, outlined the important steps in making magnesium castings. Twenty years ago the casting of magnesium had not developed into a successful process, but by 1928 the technique of handling molten magnesium was sufficiently understood so that the Wright Aeronautical Corporation began to make magnesium castings on a commercial scale in a small foundry space. From that time on, the use of magnesium castings has increased until today as many as two hundred different aircraft parts are so produced.

Magnesium has replaced aluminum for many of the less highly stressed parts, and generally speaking, of all the various engine parts made from aluminum a dozen years ago, from 25 to 30 per cent are made from magnesium today. The magnesium castings used in the Wright plants are made from AMS 4424 alloy, also known as Dow Chemical Alloy H, which was selected for its strength and good machining qualities. This alloy contains 6 per cent aluminum, 3 per cent zinc, and 0.02 per cent manganese, the remainder being magnesium.

The foundry practice in making magnesium castings may be briefly described as follows: Both cores and molds are made in the conventional manner, but unusual care is taken in the selection of the sand, which is a pure silica, thoroughly washed to remove all clay and organic matter, and carefully graded as to grain size. The necessary clays and binders are then added under controlled conditions to produce a synthetic sand, and an inhibitor is added to prevent burning of the metal in the mold. The inhibitor consists of ammonium silicafluoride and sulphur, which react to form a protective skin on the metal. In addition, where there are large cavities in the molds, these are flooded with sulphur dioxide to displace entrapped air and produce a neutral atmosphere.

The melting is done in 500-pound oil-fired furnaces, which are kept filled with remelt metal. Prior to pouring, this molten metal is ladled into 150-pound crucibles, into which one ingot of virgin metal is placed, and the temperature is brought to from 1250 to 1300 degrees F. Flux is then thoroughly stirred in to clean the metal, and a heavy layer of flux is spread over the surface to exclude oxygen. The temperature is then raised to 1650 degrees F. and held for five minutes. This superheating is extremely important, since it results in improved physical properties and finer grain.

The crucible is now removed from the furnace and placed in a pouring cradle, where it is allowed to cool to the pouring temperature of from 1400 to 1450 degrees F. The scum and flux are scraped off, and a new layer of flux consisting of half sulphur and half boric acid is spread over the surface. Pouring is done quickly, with an attendant standing by with a flux sprinkler ready to re-cover any breaks in the surface. Sprues and risers are also covered with flux as they reach the top of the mold opening.

Test bars are cast from each crucible of metal, and these are heat-treated at the same time as the corresponding casting. They are then forwarded to the laboratory, where they must pass physical tests for hardness, grain structure, etc., before the casting leaves the foundry. Two heat-treatments are employed. Care must be taken to see that the castings are free from dust or other inflammable material before they are put in the furnaces, so as to avoid danger of fire. They should also be well supported to prevent them from bending or becoming deformed under their own weight.

For the first, or solution treatment, the parts are heated uniformly to 640 degrees F., and then the temperature is increased to 710 degrees, the parts being held at this temperature for fourteen hours; or the temperature may be raised to 725 degrees and maintained for twelve hours. This treatment will give a Brinell hardness of 51 with a 10-millimeter ball and a 1000-kilogram load. After cooling in free air, the parts may be straightened if necessary, and are then passed to the aging furnace, where they are heated uniformly to 350 degrees F. and held at that heat for sixteen hours. They are then checked to Brinell 62.

Castings that must withstand oil pressure are tested either by placing water in the part under pressure and measuring the amount leaking through or by applying air pressure to the part under water and measuring the amount of air bubbling through. The method used, the pressure applied, and the maximum allowable leakage per unit area vary with individual parts. Those that leak within an allowable range are impregnated, and those leaking over this range are rejected.

* * *

"Whenever we are starting a new thing, if somebody comes to me and says 'Don't you think that you are going to have a lot of trouble?' I say, 'Sure, any time you start to do something new I can guarantee that you will have trouble.' Success depends on whether you know how to overcome trouble or not."—*Charles F. Kettering, Vice-president, General Motors*

Engineering News

Steam Turbine Locomotive Now in Service

A direct-drive steam turbine locomotive has recently been placed in service on the Pennsylvania Railroad for long-distance high-speed passenger and freight service. This geared turbine locomotive is capable of producing 6900 shaft H.P., and is the joint product of the Pennsylvania Railroad, the Westinghouse Electric & Mfg. Co., and the Baldwin Locomotive Works.

Higher efficiency and smoother propulsion are the most important of several advantages claimed over the conventional reciprocating drive. Since power is applied evenly through the gears, the unbalanced forces inherent in a reciprocating engine are eliminated. An increase in efficiency of approximately 20 per cent not only means a saving in fuel, but also greater power output from a locomotive of given dimensions.

Designed for fast, long-haul passenger and freight service, the new locomotive operates at speeds up to 100 miles an hour. Two turbines, one for forward motion and one for reverse, are connected through double helical reduction gears to the driving wheels. Stoker-fired, the locomotive uses coal as fuel. The steam pressure at the boiler outlet is 310 pounds per square inch gage, and the temperature of the steam 750 degrees F., which is common for modern locomotives.

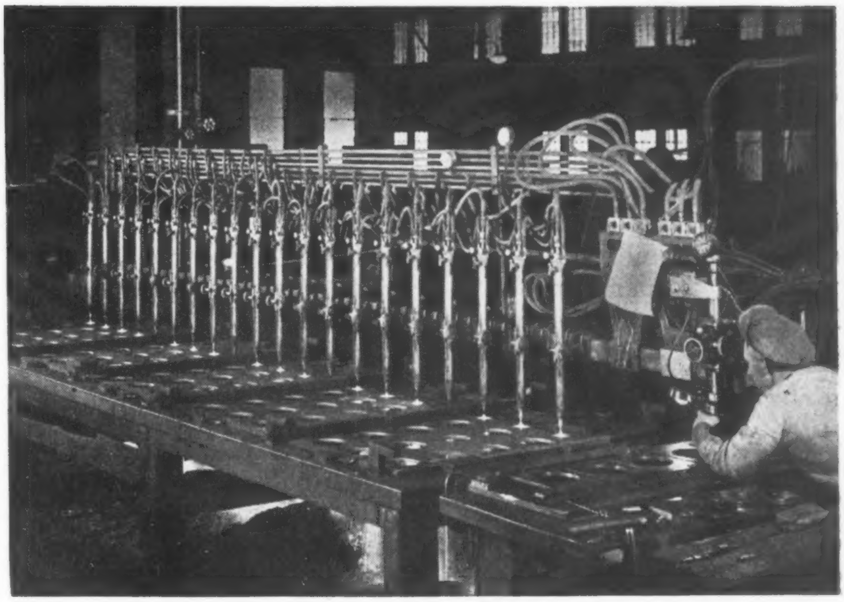
Induction Heater for Brazing, Soldering, and Heat-Treating

An electronic induction heater for brazing, soldering, annealing, hardening, and heating for forging has been brought out by the Allis-Chalmers Mfg. Co., Milwaukee, Wis. This new equipment can be adapted to a wide variety of metal-heating applications without the use of radio frequency transformers. Predetermined automatic timing controls assure uniform heating. The operator simply pushes the starting button, and when the heating operation is completed, the unit shuts off automatically.

Roughness Meter—New Device for Measuring Surface Finish

To enable surface finish to be measured in cases where comparatively rough surfaces are encountered, as in high-explosive large-caliber shells, the Physicists Research Co., 343 S. Main St., Ann Arbor, Mich., has developed a device known as a "roughness meter." This device measures the average roughness of comparatively coarse surfaces in the same manner as the Profilometer measures the finish of smoother machined surfaces. The readings on the roughness meter are directly in micro-inches, showing the average roughness of the surface being

This Motor-driven Alligator Shear, in Action at One of the Pennsylvania Plants of the General Electric Co., Chews up Scrap Steel to Feed the War Machine. The Shears Reduce the Scrap to a Size Suitable for Steel Mills. A Magnet Picks up the Pieces and Drops Them into a Freight Car for Transfer to the Mills



Twenty Torches Work in Unison Cutting Holes in Steel Plates at the By-Products Steel Corporation—a Division of the Lukens Steel Co., Coatesville, Pa.

measured. The meter and the scale selector provide full scale ranges of 300, 1000, and 3000 micro-inches. The roughness meter resembles the Profilometer in appearance and its principle of operation is similar.

Glass Tanks for Electroplating Baths and Hot Acids

No material could be more suitable than glass for tanks and containers in electroplating plants, and for industrial operations where hot acids are used, except for the fact that glass, as produced in the past, has been too brittle for this application. On account of its brittleness, glass could not be used for this purpose, although its resistance to the corrosive action of almost all acids, except hydrofluoric acid and hot caustic, would have made it ideal for such use.

In an effort to produce a glass material that could be employed for industrial purposes such as mentioned, research workers at the Pittsburgh Glass Co., Pittsburgh, Pa., developed what is know as the Herculite process, by means of which the strength of glass has been greatly increased.

With the manufacture of the first all-glass tank about eighteen months ago, it is believed that the answer was found to the problem of industrial glass tanks for corrosive solutions. Whereas the eventual breakdown of tanks made from other materials has been accepted as an inevitable maintenance problem, this difficulty is now overcome by the use of tanks made from glass. Such tanks have already been installed in several hundred industrial plants. They will stand an instantaneous temperature shock of 400 degrees F., and continuous working temperatures of from 500 to 600 degrees F. Pickling and plating solutions seldom have a temperature of over 250 degrees F.

Herculite glass shows great resistance to impact. A piece 12 inches square and 3/4 inch thick, supported only at the edges, will withstand without cracking the shock of having a 5-inch duck-pin ball dropped on it from a height of 26 feet.

Some of the glass tanks now produced are made entirely of either opaque or transparent glass 5/8 to 1 1/4 inches thick, depending upon service requirements. The maximum inside size of such tanks is 8 feet long by 5 feet 10 inches wide by 5 feet deep. Other tanks have a 1/2-inch glass lining inside a steel shell. This type is used when larger tanks are required than those made entirely from glass.

Post-War Application of Industrial X-Ray Inspection

After the war, X-ray inspection in industry will undoubtedly be much more widely employed than in the past. There is now an X-ray machine, known as the "Micronex," that will take pictures in one millionth of a second. This device actually makes it possible to photograph the flight of a projectile within a gun barrel or its action as it pierces armor plate.

Another development is miniature radiography. Don Morgan, supervisor of industrial X-ray application engineering of the Westinghouse Electric & Mfg. Co., at Baltimore, Md., says that this process permits a shadow picture of a normal X-ray operation to be photographed on a very small film with an automatic camera. This innovation will make it possible to perform X-ray inspection at production line speed with a great saving in film cost.

Editorial Comment

In all human affairs, the pendulum swings back and forth with fair regularity, always seeking an equilibrium. It is not so long ago that a great many employers tried to prevent labor from organizing into unions. These endeavors were contrary to fundamental American conceptions that men in all walks of life have a right to join together in associations for furthering their own interests by constitutionally lawful efforts.

Extremes in Either Direction Must be Ruled out

Then the pendulum swung over, and in so doing, swung too far toward the other side. Labor unions claimed it as their right—and in this they were aided and abetted by the Government—to prevent their fellow workers from obtaining employment unless they belonged to a certain association or union. This state of affairs we have with us today. This claim of the labor unions is as un-American and contrary to our inherited conceptions of freedom as were the efforts to prevent men from joining together in unions.

Now there are indications that the pendulum is ready to swing back to an equilibrium, an equilibrium where all concerned—unions, non-union workers, and employers—will have their rights, as well as their responsibilities, defined and recognized. One of these indications is to be found in the amendments to the state constitutions that were adopted by two states—Arkansas and Florida—at the elections last Fall.

The Pendulum Begins to Swing Back to a Fair Normal

The Arkansas amendment reads, "No person shall be denied employment because of membership in or affiliation with or resignation from a labor union, or because of refusal to join or affiliate with a labor union; nor shall any corporation or individual or association of any kind enter into any contract, written or oral, to exclude from employment members of a labor union or persons who refuse to join a labor union, or because of resignation from a labor union; nor shall any person against his will be compelled to pay dues to any labor organization as a prerequisite to or condition of employment."

The Florida amendment was to the same effect, providing that "the right of persons to work shall not be denied or abridged on account of membership or non-membership in any labor union or labor organization."

This is the road to fair dealings. The time has come for a recognition of the fact that any nation that expects to remain a democracy must not create special privileges for any favored class, be that class composed of either employers or employes.

Social security, as it applies to unemployment relief—commendable and unavoidable as it is as a last resort—should be looked upon as a necessary evil that we should all shun if we are able to do so. Relief money is like the medicine taken by a sick person—it tides him over his illness; but surely it would be more agreeable to feel well and be able to eat a beefsteak instead of taking medicine.

Beware of Having to Divide Too Little Among Too Many

When there is a great deal of unemployment and the Government pays relief, the nation is sick. When everybody is employed and working hard, receiving good wages for what they are doing, and using these wages to buy the products of industry, so that industry needs to employ still more people to keep up with the demand, then the nation is healthy.

When there is unemployment and relief, what little there is produced must be divided between all; and when so divided, it makes a poor showing. This is a case of dividing too little among too many. When everybody is able to buy the products of industry freely with the wages received for a full day's work, he helps to employ himself and his fellow workers. In that case, the nation eats beefsteak instead of taking relief medicine.

If industrial managers, labor leaders, and Government would all work together toward a common end, we could expect, in the future, abundant production to divide between the millions and millions of workers that help by hand and brain to produce. There is no other road to national well being and prosperity.

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Mechanism for Varying Speed of Slide

On a certain type of forming machine it was necessary to modify the action of the reciprocating slide carrying the metal-tape forming tools, so that a part of the forward and return stroke of each cycle of slide movement could be increased considerably in speed. In addition, the starting and finishing points of such accelerated speeds were to be variable within specified limits, and a simple, inexpensive means of making such changes in speed was needed.

The illustration shows the simple, smooth-running mechanism designed to effect the changes specified. The left-hand view shows the relative positions of the levers, etc., at the beginning of the cycle of operations, while the right-hand view indicates their positions at the end of the forward stroke. In the middle is an end elevation view.

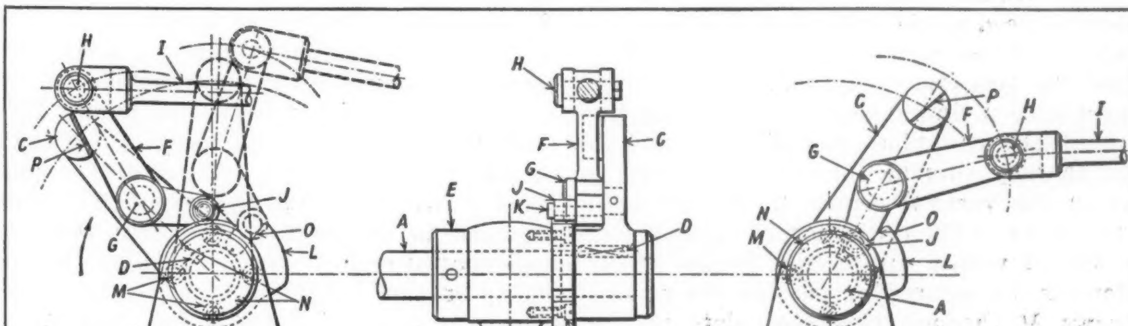
The drive to the slide was transmitted from an oscillating drive-shaft *A* having a regular unvarying angular velocity and a fixed amplitude, while the total length of travel of the driven slide had to be kept constant. Shaft *A* is made a free running fit within the bore of the pedestal bearing bracket *B*. Secured by key *D* to this shaft is the lever *C*, which is prevented from endwise movement beyond due working clearances by the head of the shaft at one side of the lever and the retaining collar *E*.

Attached to the side of the lever *C* is the bellcrank lever *F*, which swings easily on the fixed-head stud *G* that is secured to lever *C*. The upper end of lever *F* is pivoted on stud *H*, which passes through the slotted knuckle end of the connecting-rod *I*. The latter member is connected at its other end (not illustrated) with the end of the driven reciprocating slide.

To the lower and shorter arm of lever *F* is attached a hardened and ground steel roller *J*, fulcrumed to revolve easily on the stud *K*, the head of which serves to retain the roller in correct endwise location.

Fitted on a hub machined at the right-hand side of pedestal *B* and concentric with the bore in which shaft *A* oscillates is the disk-shaped cam-plate *L*, secured by the screws *M* and two dowel-pins *N* to withstand radial thrust. The cam is of the slotted type, the slot *O* being wide enough to permit roller *J* to pass readily. The slot is situated in a radial position, and is deep enough to insure free working of the roller as the bellcrank lever *F* swings on its fulcrum *G*.

It will be seen that the rim of the cam-plate is built up in diameter for a short distance at the right-hand side of the slot *O*. The roller *J* is normally held in contact with the rim portion of the cam-plate at the left of the slot, being maintained in this position by the stepped portion *P* of the boss at the end of lever *C*. The straight side of this step is so arranged as to



Lever Type Transmission by Means of which Variable Fast and Slow Rates of Travel are Transmitted to a Reciprocating Slide Attached to Connecting-rod I from Reciprocating Shaft A

bear against the left-hand side of the bellcrank lever F. In this position, sufficient clearance must be left between the step and the side of the lever to permit the roller to rotate freely.

In operation, commencing the cycle of movements from the position shown in the left-hand view, shaft A is oscillated toward the right, carrying with it the lever C, and this, in turn, carries along at the same speed the bellcrank lever F and the connecting-rod attached to the slide. Throughout this stage the roller J runs along the circular rim of the cam-plate L in advance of the slot O. Thus the driven slide is actuated at the same slow speed as the driving shaft.

This slow speed will continue until the roller reaches the slot O in the stationary cam-plate. As soon as this point is reached, the roller passes down the slot, and continued movement of lever C causes the bellcrank lever F to be swung round on its fulcrum stud G, thereby imparting to the connecting-rod a movement at an increased speed—greater than that possessed by the rod during the first stage of its movements. The point of the start of this rapid rate of speed is shown in heavy broken lines super-imposed upon the left-hand view. When the roller is in radial line with the slot O, the built-up side of the slot insures the correct entrance of the roller, which might not occur if the length of the slot sides were identical.

The position of the levers at the termination of the clockwise stroke of the shaft is shown in the right-hand view, from which it will be noted that the roller has passed well down the slot O, and the bellcrank lever F is accordingly swung around its fulcrum stud. Thus the first half of the complete cycle of movements of the driving shaft A imparts a slow speed to the reciprocating slide, followed by a much quicker rate of travel throughout the later portion of its stroke.

When shaft A starts the second half of its cycle by moving backward toward the left, the driven slide will start off at a fast rate, followed by a slower speed as the roller J leaves the slot. Thus each cycle of motions affords to the slide two slow and two fast movements.

By providing a simple means of adjusting the position of the cam-plate radially on its hub bearing, thereby altering the position of slot O relative to the vertical center of the arrangement, the point of the beginning of rapid travel can be varied within appreciable limits. This provision can be secured by passing the retaining screws M through elongated slots in the bracket B, thus enabling the cam-plate to be shifted. This will entail the omission of the dowel-pins N, which can be used when the cam-plate does not have to be moved.

This mechanism gives extremely smooth running and shockless transmission. It is simple, both in construction and design, inexpensive, and has simple means for changing the timing and duration of different speed rates for the driven slide.

B. M.

* * *

Automatic Feeding Mechanism for Drill Press

By L. KASPER

The attachment here illustrated has been applied to a drill press to provide automatic power feed and, in addition, to feed the drill into the work, disengage the feed when the drill has reached the required depth, return the spindle to the starting point, and then re-engage the feed. The work is removed and replaced by a new piece during the return movement of the spindle. This arrangement resulted in a considerable increase in production, with greatly reduced operator fatigue.

A front view of the attachment is shown in Fig. 2 of the illustration, and a plan view in Fig. 3. The spindle A carried in quill B is fed into the work by the rack D and pinion C. The rack and pinion are part of the original equipment; a handle attached to shaft S which carries pinion C has been removed. A worm-gear P is carried on shaft S in place of the handle. The bracket I pivots on stud J, which is carried on a bracket attached to the head of the press. This bracket is not shown, however, as it must be made to suit the individual application.

Bracket I supports the shaft M, which carries the worm K and sheave N. Worm K is keyed to shaft M, and is provided with a hub at one end which supports the compression spring L, shown partly compressed in Fig. 2. Shaft M is rotated in the direction indicated by the arrow by the belt O driven from a sheave carried on the overhead horizontal shaft which furnishes the power for the driving spindle A.

The worm K meshes with the worm-gear P, rotating it in the direction indicated by the arrow. Worm-gear P transmits its motion through shaft S to pinion C which, meshing with rack D, produces a downward movement of quill B. Pawl H swivels on stud R, carried on the bracket attached to the head of the drill press. The hook-shaped end of pawl H engages the hooked end of bracket I, holding it in position to obtain proper meshing of worm K and gear P.

Bracket E is clamped to quill B and carries the screw F. Rod G passes through bracket E and is attached to the end of bracket I. Cable T, attached to bracket E, passes over an overhead pulley and carries a weight at the other end of sufficient size to raise the quill B and spindle A against the force exerted by gravity.

The attachment operates as follows: The rotation of shaft *M* drives the quill *B* downward through the action of worm *K*, worm-gear *P*, pinion *C*, and rack *D*. This movement continues until screw *F*, carried on bracket *E* and moving downward with quill *B*, comes in contact with the arm of pawl *H* and disengages it from bracket *I*. Bracket *I*, acted upon by the force of gravity and the pull exerted by belt *O*, is caused to swivel on stud *J* and disengage worm *K* from gear *P*. When this occurs, the downward movement of quill *B* discontinues and *B* is drawn upward by the action of the weight attached to the end of the cable *T*.

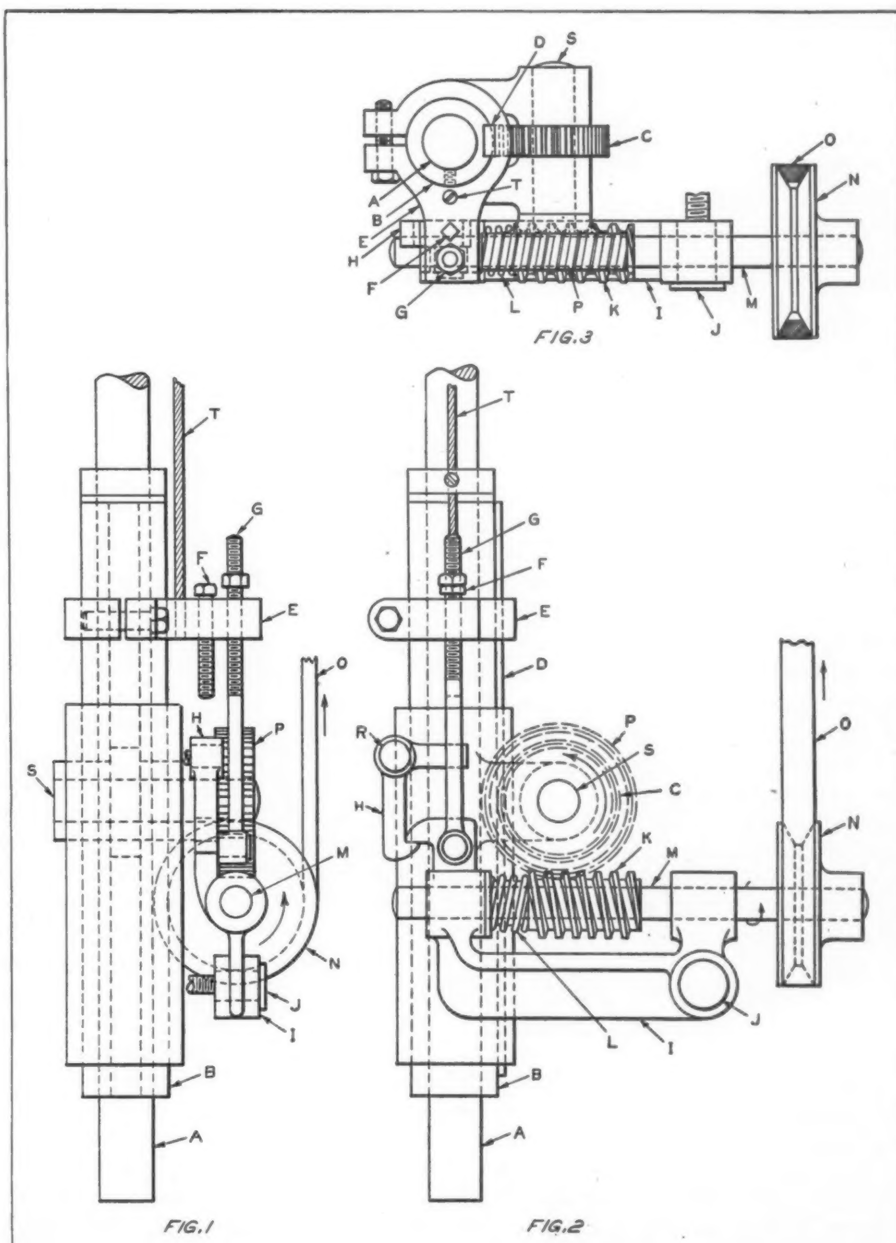
The upward movement of quill *B* continues until bracket *E* contacts with the nut on rod *G*, at which point bracket *I* is again raised to engage the pawl *H*, thereby re-engaging the worm *K* and gear *P* and again causing spindle *A* and the tool to be driven downward.

When worm *K* is disengaged from gear *P*, the spring *L* causes shaft *M* to be moved axially until worm *K* makes contact with the bearing of shaft *M* in bracket *I*. The purpose of this movement is twofold in that it permits some of the shock resulting from re-engagement to be absorbed by spring *L* and also permits proper engagement of worm *K* and gear *P* in case they should strike on the tops of their teeth.

During the feeding operation of the cycle, worm *K* is held in contact with the bearing of the shaft in bracket *I* by the resistance caused by the friction of the quill *B* in the drill press head. The operation of the drill press is completely automatic, it merely being necessary for the operator to remove and replace the work.

Magnetic Comparators for Inspecting Ferrous Parts

The General Electric Co.'s magnetic comparator, which provides a quick, simple non-destructive method of inspecting ferrous parts, has been redesigned to better meet the requirements. This portable device is used for testing rods, bolts, springs, and small fabricated parts. The part to be inspected is compared with a preselected standard of the same size or shape to detect variations in composition, hardness, and other characteristics that affect magnetic properties. The deflection of a pointer on the instrument dial indicates variations in the magnetic characteristics of the parts being inspected from those of the standard.



Figs. 1 to 3. Side, Front, and Top Views of Automatic Feeding and Reversing Mechanism Applied to Drill Press

Selecting the Correct Speeds and Feeds for Cylindrical Grinding

By S. S. SHOEMAKER
Landis Tool Co., Waynesboro, Pa.

Determining Traverse and In-Feed of Wheel—Last of a Series of Three Articles

FOR rapid stock removal, as in roughing cuts, it is best to use as rapid a traverse as possible. The limit is the traverse at which the cuts merely overlap. Beyond that, the operation would be essentially the same as thread cutting—a spiral pattern would be ground on the work, which is, of course, useless. Hence, the traverse should be so set with reference to the work speed that the wheel will travel nearly, but not quite, the full width of its face at each revolution of the work. To give more even wheel wear over the face of the wheel, thus producing a more even surface on the work, it is sometimes desirable, especially for finish cuts, to have the wheel traverse in fractions of its width—as 1/2, 1/3, or 1/4—at each revolution of the work. Evidently, the traverse for roughing cuts is primarily determined by the work rotational speed and the width of the wheel face. Faster work speeds permit faster traverse rates.

The wider the wheel face, the farther can the wheel move per revolution of the work, thus increasing the rate of material removal, up to certain limits. For maximum rate of material removal, it is therefore desirable to use as wide a wheel as is practical. The limiting factors are the design of the machine, the dimensions of the work, and the power applied by the wheel drive motor. If the machine is used for the purpose for which it was originally bought, it is best to use the wheel width recommended by its maker. In grinding small lots of miscellaneous parts, the dimensions of the smallest part may limit the wheel width.

With a wide wheel and a fast traverse, more cutting points are always in contact with the work; it is therefore useless to try to equal the production of that combination with a narrow wheel and increased depth of cut.

Good Surface Quality Requires Reduced Traverse

For the generation of good surface quality, the width of the wheel does not determine the traverse, although it still determines the speed of the operation to a considerable extent. It is perfectly possible to produce the desired surface with a wheel having a face width of 1/2 inch or 1 inch, but it may take longer than with a wider wheel. For ordinarily good surface quality, the traverse should not exceed 1/2 inch for each revolution of the work. For extremely fine surfaces, 1/8 inch traverse is not too little. For "ultra finish," the final pass should be at the lowest traverse speed that can be obtained on the machine.

An important aspect of traverse is the period when the wheel, having been allowed to pass off the end of the work for from one-third to one-quarter of its width, "dwells," that is, cuts without traverse or in-feed. The dwell is to make up for the fact that the entire face of the wheel does not pass over the end of the work, and yet grinding must go on for the predetermined time or the work will be over size at the ends.

On the other hand, it is important not to let the wheel move too far off the work nor to allow too long a dwell, for either condition will result in the work being under size at the ends. Too much dwell also tends to glaze the wheel and reduce its cutting ability.

Depth of Cut, or In-Feed

Closely tied in with traverse is the depth of cut, or in-feed. It is highly important in determining production, wheel wear, and surface quality. Because the amount of in-feed is the predominant factor in determining compression stresses, it has important effects on wheel action; if too great, it will distort the work and make it inaccurate or burn the surface.

As the amount of in-feed is increased, the chips become thicker, which results in greater production. On the other hand, the increased compression makes the wheel act softer and wear faster. For lowest all-around costs—which depend upon both production rate and wheel cost—it is necessary to balance these two factors.

Usually, in-feed varies between about 0.00025 and 0.004 inch per traverse. The most common mistake is probably using too great an in-feed. To try to remove stock too quickly at the beginning of a cut breaks the wheel face, causing uneven wheel wear and, of course, poor finish.

To use a heavy in-feed safely, even on roughing cuts, the work must be short and thick enough to stand the heavy pressure and have

plenty of work-rests to support it, as well as large, well lubricated centers and center holes. Generally, fine-grit wheels and hard wheels cause higher pressures at a given amount of in-feed than soft or coarse wheels.

When a reasonably good finish is the aim, time will be saved, in the long run, by feeding the wheel slowly and regularly, thus building up a good finish from the very start of the grinding operation. For the finest finishes, as for instance in roll grinding, it is the best practice to "finish out," or "spark out," each wheel—that is, allow it to make a final traverse without any in-feed.

If the work is sufficiently big and rigidly enough supported to stand up under a heavy cut, and finish is not the primary object, the wheel should be fed in at each reversal of the traverse to the point where it is cutting at its maximum capacity and yet is not forced enough to wear out of shape. In determining this point, experimenting is necessary. This is an excellent example of the difficulty of giving set rules on speeds and feeds; for it is sometimes found, when feeding in for a heavy cut, that the wheel will work more satisfactorily and keep its shape better when taking a heavy cut than when taking a light one.

Because of the close connection between traverse and in-feed as they affect wheel action, trouble is likely to be encountered in plunge-cut, or straight-in, grinding, where there is no real traverse, or at most only a slight oscillation of the wheel. Here heavy in-feed to get production may set up such a high pressure as to cause excessive wheel wear. In that event, reducing the work speed will make the wheel act harder and so offset the tendency to softer action induced by the increased feed.

The Grinding of Cast Iron

An exception to the usual rule for rough-grinding at fast traverse is the case of cast iron. The best results on that material are often secured with slow traverse and heavy in-feed, so that most of the grinding is done with the corner of the wheel. For finishing cast iron, it is advisable to make as few passes as possible, so that the wheel will not glaze rapidly. For example, on cast-iron and aluminum-alloy pistons experience shows that the most efficient practice is to rough-cut in a single pass by feeding in the full amount at the start and then traversing. The pistons are finish-ground in four passes—two round trips of the table.

Automatic in-feed speeds production on work for which it is suitable by enabling the operator to busy himself at other tasks, such as getting the next piece ready for the machine while one piece is being ground. Automatic in-feed is all but indispensable on work so delicate that anything but a very slow, smooth feed would burn it. Such a piece is an electric shaver head, the radius of which has to be most carefully ground. This is done with a hydraulic in-feed set to feed at the rate of only 0.006 inch per minute. Since the edges of the razor are exceedingly thin, any jumping of the wheel-base would immediately burn the work sufficiently to make scrap of it. The final thickness of the edge is 0.002 inch.

To sum up, these are some common difficulties in grinding caused by faulty feeds or speeds, and suggestions for overcoming them:

1. Regularly spaced chatter marks. Due to vibration caused by too fast work speed. Reduce work speed until vibration ceases.
2. Fine spiral or thread on work. Too great wheel pressure. Reduce in-feed.
3. Uneven traverse lines. Worn traverse drive parts. Adjust or replace.
4. Grit marks. Improper cut by finishing wheel. Start finishing cut with high work and traverse speed. Finish with high work and slow traverse speed, allowing wheel to spark out.
5. Lack of cutting action—glazing, loading, burning. Wheel acts too hard. Increase work and traverse speed. Decrease wheel speed. Increase in-feed.
6. Wheel marks; rapid wheel wear; not holding cut; work tapered. Wheel acts too soft. Decrease work and traverse speed and in-feed; increase wheel speed.
7. Metal lodged on grains or in wheel pores. Wheel acts too hard. Use same methods as under (5).
8. Wheel looks shiny and feels "slick." Wheel acts too hard. Use greater in-feed.
9. Work out-of-parallel. Too much wheel pressure. Decrease in-feed.
10. Check marks on work. Wheel acts too hard. See (5).
11. Work discolored. Burning. Bring wheel to work more gradually. Decrease in-feed. Eliminate belt or wheel slippage.

There are, of course, other causes for these troubles, such as using the wrong grade of wheel, wrong or insufficient coolant, and so on. Those faults should be looked for first. If correcting them does not cure the trouble, it is probably due to one of the causes listed in the foregoing, and can be corrected by manipulating the various speeds and the feed.

* * *

"You will never do a real job unless you have the ability to take people as they come and put them into a team. Mass production is not mob production; it is team production."—*O. E. Hunt, Executive Vice-president, General Motors*

Questions and Answers

A Department in which the Readers of MACHINERY are Given an Opportunity to Exchange Information on Questions Pertaining to the Machine Industries

Complaints Regarding Unsatisfactory Machines

P. F.—Some time ago we sold a machine that proved unsatisfactory to the purchaser. However, he waited almost a year to notify us to that effect. In these circumstances, are we liable, even though we guaranteed the machine to be satisfactory for the purpose for which it was bought?

Answered by Leo T. Parker, Attorney-at-Law
Cincinnati, Ohio

According to recent higher court decisions, all purchasers who rely upon a guarantee must without "unreasonable" delay register complaint regarding defects or poor quality of the purchased merchandise. For example, in James v. International Harvester Co. [172 S.W. (2d) 671], reported August, 1943, the higher court said: "A buyer, after discovering defects in a machine, must elect to take action promptly after discovering the defect, and unless prevented by the seller from doing so, offer to restore the property and rescind the contract. Even this right is lost if the warranty relied on is an expressed warranty and the specified conditions upon which the warranty is made available to the purchaser are not complied with."

The legal effect of this decision means that if a seller gives an expressed guarantee regarding his product, the purchaser must *promptly* report to the seller all complaints. Failure to do so may result in the purchaser *not* receiving a favorable verdict in a later suit. If the machine is not warranted by an expressed guarantee, and the seller knows the intended uses of the machine by the purchaser, an implied guarantee exists. In either event, the purchaser must promptly report a breach of the guarantee.

Rolling-Mill Guides

A. D.—What composition of alloy cast iron is most suitable for steel rolling-mill guides?

Answered by Editor "Nickel Cast Iron News"
International Nickel Co., Inc., New York City

The first choice would be a composition often used for brake-drums, consisting of about 3.10 per cent total carbon, 1.60 per cent silicon, 2.00 per cent nickel, and 0.60 per cent chromium.

A second composition, which is somewhat harder than the first, and should be more wear-resistant, is as follows: Total carbon, 3.00 to 3.25 per cent; silicon, 1.00 to 1.40 per cent; nickel, 2.50 to 3.00 per cent; chromium, 0.50 to 0.75 per cent.

The next iron on our list is a chilled roll type of the following composition: Total carbon, 2.75 to 3.00 per cent; silicon, 1.20 to 1.50 per cent; nickel, 1.50 to 2.50 per cent; chromium, 0.50 to 1.25 per cent. When sand-cast, this should develop a hardness exceeding 500 Brinell.

* * *

Thread Gages Made from Meehanite Prove Successful in Service

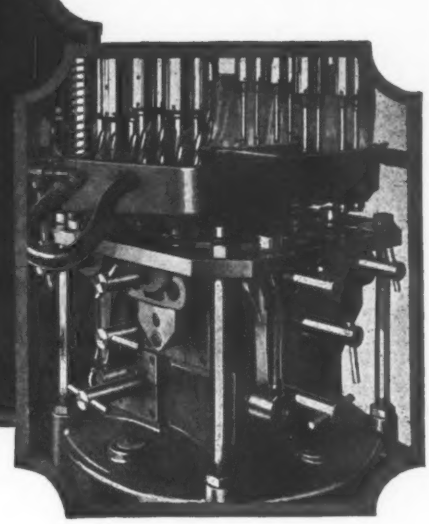
Faced with a serious shortage of thread gages for the manufacture of war material, the Continental Gin Co., Birmingham, Ala., experimented with Meehanite thread gages and found them very satisfactory. According to information obtained from the Meehanite Research Institute, thousands of these gages have now been put in service, and they have proved not only to be successful, but to have definite advantages both in gage production and in the subsequent inspection of the manufactured product. The ready machinability of Meehanite permitted increased speed in the making of the gages. The service life of these Meehanite gages is stated to have been as much as 25 per cent greater than that of gages made from steel.

* * *

Electronic Heating

In the article entitled "Electronic Heating of Metals and Non-Metallic Materials," published in March MACHINERY, mention was inadvertently omitted of the following manufacturers of electronic equipment for induction and dielectric heating, who cooperated in supplying data and illustrations for that article: Federal Telephone and Radio Corporation, Newark, N. J.; General Electric Co., Schenectady, N. Y.; Tocco Division, Ohio Crankshaft Co., Cleveland, Ohio; Radio Corporation of America, Camden, N. J.; and Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Design of Tools and Fixtures



Extension Device for Dial Indicator

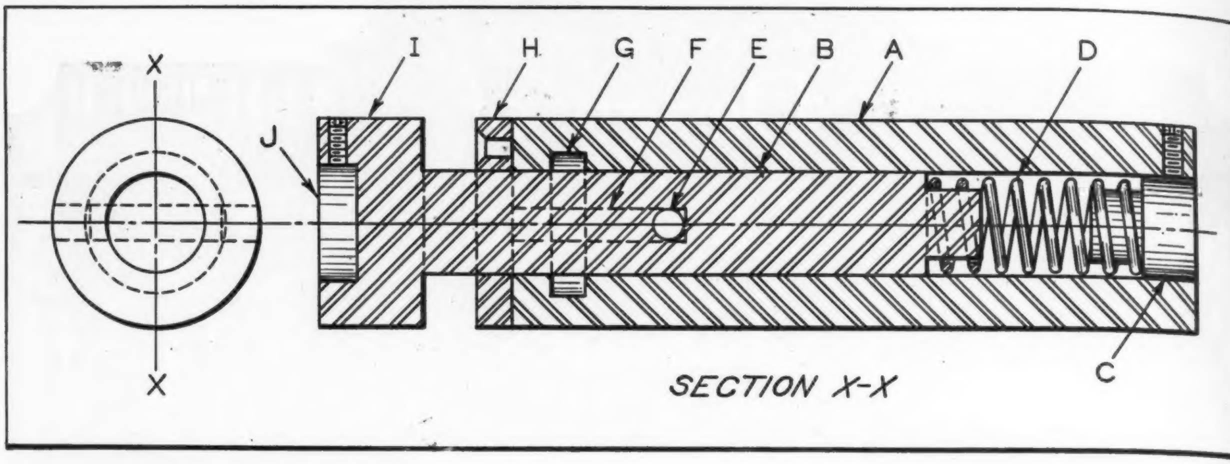
By DANIEL E. McDONALD, Sunnyside, L. I.

In setting up work in a lathe, it is sometimes necessary to use an indicator to test the trueness or alignment of a certain bore with the machine spindle when the bore is located at some distance from the face of the work. This testing operation is particularly important when it is necessary to reset work and also when there are two or more bores that must be concentric within very close limits. The extension device for the dial shown in the illustration has proved of great help in setting up work of this kind.

The body *A* of the extension consists of a piece of 5/8-inch brass tubing, 24 inches long. In one end of this tube is assembled a terminal fitting *B*. One end of this terminal fitting is pressed into the tube *A*, while the other end is threaded and split to accommodate the knurled nut *C*, which is used to hold the No. 726 Brown & Sharpe indicator securely in place.

At the other end of tube *A* a fitting *D* is installed as shown, one end being pressed into the tube, and the other end turned down to permit

Dial Indicator Equipped with Extension Consisting of Brass Tube A with its Assembled Parts Indicated by Reference Letters B to G



Holder for Mounting Button Type Threading Die at J for the Rapid Cutting of Short-length Threads

the installation of the No. 734 Brown & Sharpe adapter *E*. Prior to installing this particular fitting, the inside of the tube is fitted with four brass bushings *F*, which are equally spaced in the bore of the tube. These bushings are pressed into the tube with a tight fit.

It will be noted that the bushings *F* are chamfered at an angle of 45 degrees on opposite faces, so that the remaining supporting surface at the center is only 1/16 inch wide. This is done so that the bearing surface in contact with the extension rod *G* will be kept at a minimum. The bore in these bushings is 0.010 inch larger than the 1/8-inch diameter of the indicator rod. The equally spaced bushings within the tube serve to hold the extension rod in accurate alignment and to keep frictional losses at a minimum.

In assembling this device, the indicator attachment is first put on the tube, after which the extension rod is placed inside the tube, so that it will make contact with the indicating adapter. The indicator is then put on the tube and pushed in far enough so that one-half of the total indicator movement has been expended before the locking nut is tightened. This is done so that the spring tension in the indicator proper will force the extension rod against the indicator adapter. After being assembled, any movement of the adapter contact point will register on the indicator dial at the opposite end of the tube.

The block *H*, which is shaped, bored, and slotted as shown, is designed to hold tube *A* in place in the toolpost or other clamping member.

Revolving Die-Holder

By LEONARD J. TOURGEE, Stonington, Conn.

A revolving die-holder, which the writer made up for use in cutting a 10–24 thread, 5/32 inch long, is shown in the illustration. This holder and the button die (not shown) were developed to replace the automatic die-head previously used, which, because of the short thread length, had a tendency to pull back after cutting the first thread and spoil the work.

The die-holder shown has the tension of the spring acting in a direction opposite that of a regular automatic die-head. The spring *D* in back of the shank *B* serves to back up the button die mounted in recess *J* while it is being started on the work. Pin *E*, which is a light drive fit in shank *B*, prevents the die-holder from revolving in shank *A*. Shank *A* is held in the hexagonal turret and a stop is set so that when shank *B* has moved ahead a distance equal to the length of the thread to be cut, pin *E* will move forward in slot *F* until it revolves in groove *G*. The length of pin *E* is slightly less than the inside diameter of groove *G*. Then by reversing the work and drawing the turret back, the die can be threaded off the work.

When assembled, the plate *H* is secured by two flat-head screws. Shank *B* is inserted through plate *H* and into shank *A*, after which the pin *E* is inserted in *B* and driven into place. The members *B* and *I* are turned from one piece. Spring *D* is held in member *A* against *B* by the plug *C*. This die-holder increased production about 400 per cent.

Work Ejector Speeds up Production of Perforating and Notching Die

By WALLACE C. MILLS, Rockford, Ill.

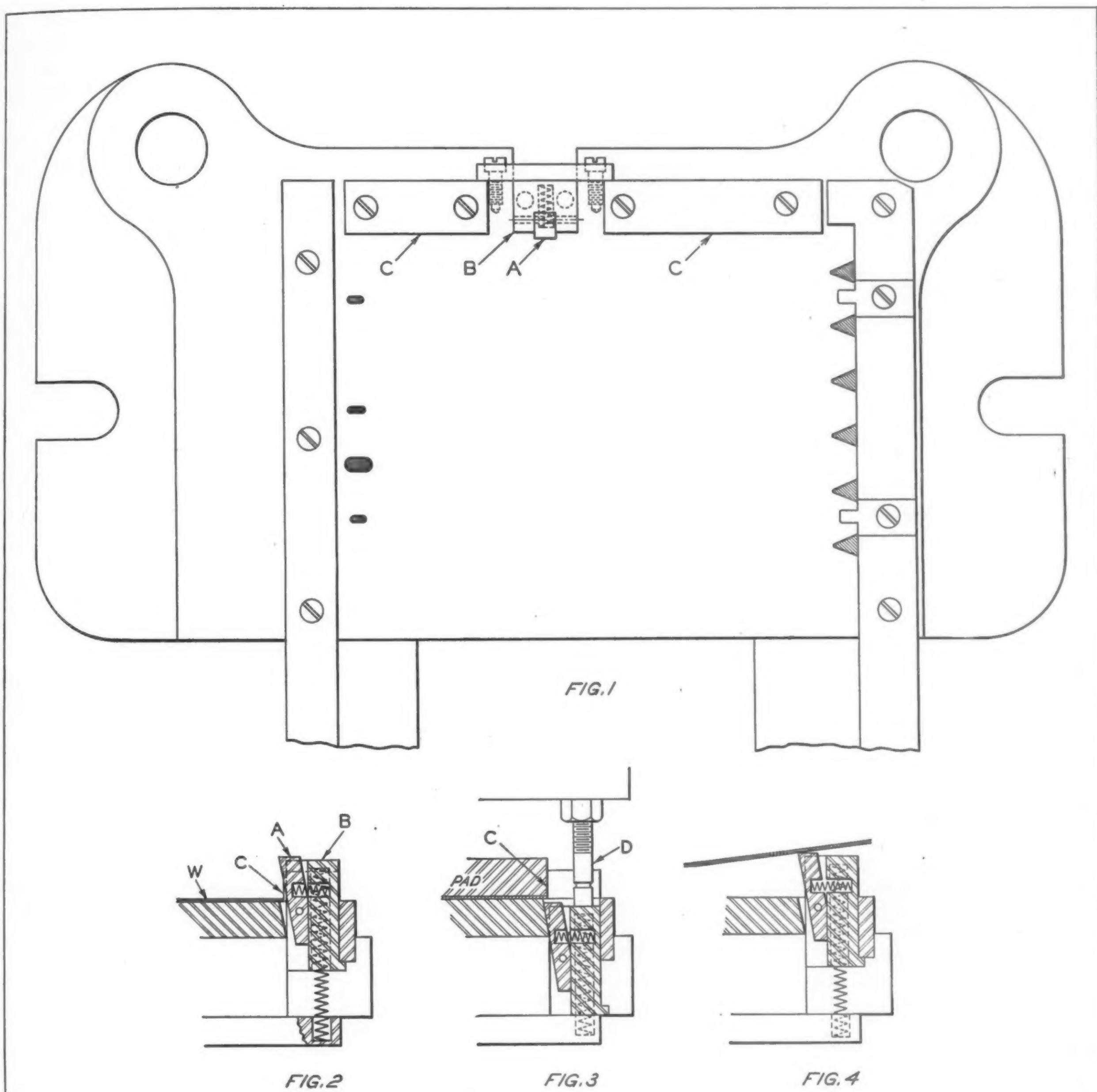
Production on a sheet-metal perforating and notching die was increased from 1300 to 1700 blanks per hour by the installation of the ejector device shown in the accompanying illustration. In the view of the die, Fig. 1, the perforating and notching punches are shown in cross-sec-

tion. Before the ejector, consisting of latch *A* and slide *B*, was added, the operator placed the blank in the die by hand and tripped the press. The perforated and notched blank was then removed by hand and stacked. With the ejector installed as shown, and with the die mounted in an inclined press, the operator simply drops the blank into the chute leading to the die and trips the press. The work is ejected automatically, and the operation is repeated with considerable saving in time.

The blank, on being placed in the chute, slides down into place against the locating bars *C* at the back of the die. In this position, as shown by the cross-section view Fig. 2, the blank *W* does not touch the ejector latch *A*. When the punch descends, the pressure pad holds the work while the ejector device is pushed down by screw *D*, as shown in Fig. 3, so that latch *A* snaps under the blank. When the punch rises and the pressure pad leaves the blank, the ejector latch *A* lifts the blank out of the die, as shown in Fig. 4, so that it slides over the ejector into an inclined chute which leads to a stacking chute.

* * *

Cleveland, Ohio, claims to operate the world's largest municipal airport. In 1944, the average departures from the airport were 140 planes a day; the average number of passengers handled was nearly 1600 a day.



Ejector-equipped Perforating and Notching Die Used on Inclined Press

New Trade Literature

RECENT PUBLICATIONS ON MACHINE SHOP EQUIPMENT, UNIT PARTS, AND MATERIALS

To Obtain Copies, Fill in on Form at Bottom of Page 217 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the April, 1945, Number of MACHINERY

Cold-Finished Steel Data Chart

JONES & LAUGHLIN STEEL CORPORATION, Pittsburgh 30, Pa. Wall chart containing data on cold-finished steel, including standard and National Emergency steels, covering tolerances; weights of steel bars; hardness conversion tables; machinability ratings; heat-treatments; carburizing, etc. 1

Electrode Selection Chart

METAL & THERMIT CORPORATION, 120 Broadway, New York City. Murex wall chart, containing information to aid the user in selecting the proper electrodes for different welding jobs. The data are divided into four groups — electrodes for mild, stainless or low-alloy steels, and hard-surfacing....2

Hydraulic Circuits

JOHN S. BARNES CORPORATION, 301 S. Water St., Rockford, Ill. Booklet 011-G, entitled "Hydraulic Circuits for Industrial Equipment," describing successful applications of these circuits to the performance of difficult and complicated machine operations. 3

Centralized Lubrication System

TRABON ENGINEERING CORPORATION, Cleveland 3, Ohio. Bulletin 442, illustrating and describing Trabon Type M positive, centralized lubrication for machinery of all kinds, including suggestions for selecting the right equipment to meet particular requirements. 4

Industrial Adhesives

E. I. DU PONT DE NEMOURS & CO., INC., Fabrikoid Division, Fairfield, Conn. Bulletin A 2945-a, descriptive of "Fairprene" cement, a new industrial adhesive. Circulars containing specifications covering various types of Fairprene cements and calking compounds. 5

Crossed-Axis Gear-Finishing Machines

MICHIGAN TOOL CO., 7171 E. McNichols Road, Detroit 12, Mich. Bulletin 900-44, illustrating and describing this company's improved Model 900 crossed-axis rack type gear-finishing machine for spur and helical gears. 6

Ball and Roller Bearings

ANTI-FRICTION BEARING MANUFACTURERS ASSOCIATION, INC., 60 E. 42nd St., New York City. Manual entitled "Ball and Roller Bearing Standard Specifications," containing a great amount of tabulated data pertaining to ball and roller bearings. 7

Actuating Equipment

LEAR, INC., Piqua, Ohio. Booklet entitled "Lear 'Know-How,'" describing present and potential uses of Lear actuating equipment, including rotary actuators, power units, flexible shafting, remote control equipment, precision gears, etc. 8

Optical Contour Comparator

FISH-SCHURMAN CORPORATION, 230 E. 45th St., New York 17, N. Y. Bulletin OC-305, descriptive of the Fish-Schurman optical contour comparator for the rapid and accurate inspection of intricate shapes. 9

Coil-Spring Lock-Washers

GEORGE K. GARRETT CO., INC., 1421 Chestnut St., Philadelphia 2, Pa. Bulletin 109, illustrating and describing the new Diamond double-coil spring lock-washers designed especially for heavy machinery. 10

Multiple-Spindle Honing Machine

MICROMATIC HONE CORPORATION, Detroit 4, Mich. Circular descriptive of the "Hydrohoner Microsize," a multiple-spindle vertical honing machine with new automatic Microsize control. 11

Crossed-Axis Gear Shaving Machines

NATIONAL BROACH & MACHINE CO., 5600 St. Jean Ave., Detroit 13, Mich. Bulletin descriptive of crossed-axis gear-shaving machines made by this company in sizes from 36 to 120 inches. 12

Master Copy Type for Pantograph Machines

GEORGE GORTON MACHINE CO., 1303 Racine St., Racine, Wis. Catalogue 1309-B, showing all styles and forms of Master Copy Type templets and patterns for all pantograph machines. 13

Visual Precision Gages

FEDERAL PRODUCTS CORPORATION, 1144 Eddy St., Providence 1, R. I. Bulletins describing two new visual precision gages—the Model 120-B1 micrometer-comparator and the Model 1330P-100 dial indicator snap gage. 14

Heat-Treatment

PERFECTION TOOL & METAL HEAT TREATING CO., 1740 W. Hubbard St., Chicago 22, Ill. Booklet en-

titled "Fifty Facts," dealing with the hardening of low-carbon steels and describing the "Ad-Life" treatment for previously hardened, finished tools. 15

Electronics

GENERAL ELECTRIC Co., Schenectady 5, N. Y. Bulletin GES-3303, announcing a complete set of training material on industrial electronics, consisting of booklets, sound films, and an instructor's guide. 16

Rotary Converters

JANETTE MFG. Co., 556-558 W. Monroe St., Chicago 6, Ill. Bulletin 13-25, describing the electrical and mechanical features of Janette rotary converters for converting direct current to alternating current. 17

Spot-Welding Machines

SCIAKY BROS., 4915 W. 67th St., Chicago, Ill. Bulletin 113-A, describing seam and roll spot-welding machines for mild steels, stainless steels and non-ferrous alloys. Tooling data for various types of welding jobs are included. 18

Belting Chart

BALDWIN BELTING, INC., 85 Chambers St., New York 7, N. Y. Transmission and conveyor belting chart, giving standard belt thicknesses for belts of all commonly used materials, together with sizes of lacings for each thickness. 19

Master Feed Fingers

HARDINGE BROTHERS, INC., Elmira, N. Y. Circular descriptive of Hardinge master feed fingers with adjustable tension for use on Nos. 00 and 0 Brown & Sharpe automatics and Davenport DA-2 automatics. 20

Fans and Blowers

BUFFALO FORGE Co., Buffalo 5, N. Y. Bulletin 3499, on Buffalo motor-driven vent sets. Bulletin 3533, listing Buffalo Type B axial-flow fans. Bulletin 3553, on Buffalo pressure blowers and centrifugal compressors. 21

Master Spindle Machine

KINDT-COLLINS Co., 12651 Elmwood Ave., Cleveland 11, Ohio. Bulletin B-3, descriptive of the Kindt-Collins Master Spindle machine for pattern shop use, in cutting wood and soft metal to irregular and standard shapes. 22

Collets and Stock Pushers

SHEFFER COLLET Co., 6432 Cass Ave., Detroit 2, Mich. Catalogue 45, illustrating and describing the complete line of "Super Grip" collets and stock pushers for all types of automatic and hand screw machines. 23

Vibration Isolators

KORFUND Co., INC., 48-15 Thirty-Second Place, Long Island City 1, N. Y. Catalogue SL 500, illustrating and describing a new universal "Vibro Isolator," designed to absorb vibration in all directions. 24

Hydraulic Universal Grinder

LANDIS TOOL Co., Waynesboro, Pa. Catalogue I 45, illustrating and describing in detail the construction of the Landis hydraulic universal grinder; typical applications are also shown. 25

Electrolimit Height Gages

PRATT & WHITNEY DIVISION NILES-BEMENT-POND Co., West Hartford 1, Conn. Bulletin descriptive of Pratt & Whitney Electrolimit height gage equipped with a new reversing attachment. 26

Wire Coating

OAKITE PRODUCTS, INC., 26 Thames St., New York 6, N. Y. Service report describing the application of the Oakite "CrysCoat" process to ferrous rods and wire in wire drawing. 27

Blast Cleaning Equipment

PANGBORN CORPORATION, Hagerstown, Md. Booklet featuring twenty-one unusual problems in blast-cleaning handled by specially designed Rotoblast and Airblast equipment. 28

Hand Cutting Tool

WILLIAM-LEONARD & ASSOCIATES, 801 Caxton Bldg., Cleveland, Ohio. Circular illustrating and describing the new Zim cutter for cutting

To Obtain Copies of New Trade Literature

listed on pages 216-219 (without charge or obligation), fill in below the publications wanted, using the identifying number at the end of each descriptive paragraph; detach and mail within three months of the date of this issue to:

MACHINERY, 148 Lafayette St., New York 13, N. Y.

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any pliable material up to 1 1/2 inches wide to required length. 29

Industrial Heating Equipment

GEHNRICH OVEN DIVISION, W. S. ROCKWELL CO., 108 Jewell St., Brooklyn 22, N. Y. Catalogue 114—a guide for selecting the right oven for baking, drying, and curing. 30

Machinery Steels

CRUCIBLE STEEL CO. OF AMERICA, 405 Lexington Ave., New York 17, N. Y. Folder containing data on the composition, properties, machinability, and applications of Max-el machinery steels. 31

Portable Batch Cleaning

OPTIMUS EQUIPMENT CO., 159 Church St., Matawan, N. J. Bulletin 4E2, entitled "Batch Cleaning in Portable Metal Washing Machines for Production, Maintenance, and Repair." 32

Isothermal Heat-Treatment of Pistol Parts

AJAX ELECTRIC CO., INC., Frankford Ave. at Delaware Ave., Philadelphia 23, Pa. Reprint of an article on "Isothermal Treatment of Pistol Parts." 33

Meehanite Castings

MEEHANITE RESEARCH INSTITUTE OF AMERICA, INC., Pershing Square Bldg., New Rochelle, N. Y. Bulletin 22, entitled "Stories of Meehanite in Industry" (127 pages, 8 1/2 by 11 inches). 34

Die Steels

FIRTH-STERLING STEEL CO., McKeesport, Pa. Circular giving performance records of H W D die steel for hot work and Cromovan die steel for cold work. 35

Plate Planers

BALDWIN LOCOMOTIVE WORKS, BALDWIN SOUTHWARK DIVISION, Philadelphia 42, Pa. Bulletin 190, on Baldwin heavy-, medium-, and light-duty plate planers. 36

Molten-Metal Pumps

RUTHMAN MACHINERY CO., 1809-1823 Reading Road, Cincinnati 2, Ohio. Bulletin descriptive of the various molten-metal pumps made by this company. 37

Slotted-Head Screws and Bolts

AMERICAN SCREW CO., Providence 1, R. I. Price list of slotted-head screws and bolts, with thumb-index for convenient reference. 38

Masonite Die Stock

MASONITE CORPORATION, 111 W. Washington St., Chicago, Ill. "Masonite Manual for the Product Designer." 39

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AMERICAN FOUNDRY EQUIPMENT CO., 555 S. Byrkit St., Mishawaka, Ind. Catalogue describing the company's complete line of Airblast equipment. 40

Boring, Drilling, and Facing Machine

W. F. & JOHN BARNES CO., 320 S. Water St., Rockford, Ill. Circular descriptive of the new Barnes basic vertical machine for drilling, boring, and facing operations. 41

Electric Equipment

GENERAL ELECTRIC CO., Schenectady 5, N. Y. Bulletin GEA-4254, on push-button units, selector switches, and lights for built-in machine tool applications. 42

Die-Casting Design

NEW JERSEY ZINC CO., 160 Front St., New York 7, N. Y. New edition of a book entitled "Designing for Die-Casting," which is a virtual handbook on the subject. 43

"Cone-Lok" Jigs

N. A. WOODWORTH CO., 1300 E. Nine Mile Road, Detroit 20, Mich. Catalogue 45-J, describing the features and illustrating the operation of the "Cone-Lok" jig. 44

Drill Rod and Cold-Drawn Tool Steel

ALLEGHENY LUDLUM STEEL CORPORATION, Brackenridge, Pa. Catalogue on carbon and high-speed steel drill rod and cold-drawn tool steel. 45

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 224-248 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning machine as described in April, 1945, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on other side of this blank.

To Obtain Additional Information on Materials of Industry

To obtain additional information about any of the materials described on page 220, fill in below the identifying number found at the end of each description — or write directly to the manufacturer, mentioning name of material as described in April, 1945, MACHINERY.

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Hydraulic Presses

JOHN S. BARNES CORPORATION, 301 S. Water St., Rockford, Ill. Bulletin 501-P, illustrating and describing the Barnes line of hydraulic presses. 46

Air-Actuated Clutches

TWIN DISC CLUTCH CO., Racine, Wis. Bulletin 139, containing complete data on the new Model P air-actuated clutch for heavy-duty application. 47

Spring-Lock Fastener

SIMMONS MACHINE TOOL CORPORATION, North Broadway, Albany 1, N. Y. Bulletin illustrating and describing the Simmons one-piece, spring-lock fastener. 48

Shaft Couplings

LINK-BELT CO., 307 N. Michigan Ave., Chicago, Ill. Book 2045, covering the Link-Belt line of shaft couplings and protective casings for roller chain couplings. 49

Surface Grinders

ABRASIVE MACHINE TOOL CO., East Providence 14, R. I. Catalogue illustrating and describing the new M-34 vertical-spindle surface grinder. 50

Matched Motor Parts

ROBBINS & MYERS, INC., Springfield, Ohio. Catalogue describing Robbins & Myers "matched" motor parts available for installation in machines and portable tools. 51

Cleaning Equipment

PRACTICAL PRODUCTS CO., 2632 Nicollet Ave., Minneapolis 8, Minn. Circular descriptive of the new "Kleer-Flo 30" electrically operated mechanical parts cleaner. 52

Aircraft Tools

ZEPHYR MFG. CO., 201 Hindry Ave., Inglewood, Calif. Catalogue illustrating precision tools for the aircraft and other manufacturing industries. 53

Data on Steel Selection

LA SALLE STEEL CO., Chicago 80, Ill. Bulletin 5, containing helpful data on the selection of furnace-treated bar steels. 54

Self-Priming Centrifugal Pumps

MARLOW PUMPS, Ridgewood, N. J. Booklet containing engineering information and other data on self-priming centrifugal pumps. 55

Air-Operated Tools

INGERSOLL-RAND CO., 11 Broadway, New York 4, N. Y. Folder 117, entitled "Air-Operated Tools for Maintenance, Construction, Demolition." 56

Oil Power Transmission for Variable Speeds

SUNDSTRAND MACHINE TOOL CO., Rockford, Ill. Bulletin 124, entitled "Sundstrand Oil Power Transmission for Variable Speeds." 57

Rebuilt Machine Tools

MILES MACHINERY CO., Saginaw, Mich. Catalogue 180, containing a list of guaranteed, rebuilt machine tools. 58

Grinding and Polishing Backstands

DIVINE BROS. CO., Utica, N. Y. Bulletin 452-DBY-1 on DBY grinding and polishing backstands. 59

Hard-Facing Data

MIR-O-COL ALLOY CO., 2416-60 E. 53rd St., Los Angeles 11, Calif. "Welders' Guide to Successful Hard-Facing." 60

Rigidized Metals

RIGID-TEX CORPORATION, Buffalo 3, N. Y. Bulletin describing "Rigidized" metals and their applications. 60-A

Electronic Heating

SCIENTIFIC ELECTRIC, 107-119 Monroe St., Garfield, N. J. Booklet entitled "The ABC of Electronic Heating." 60-B

* * *

Etched-Glass Charts for Optical Comparators

A series of etched-glass radii charts for optical comparators and contour measuring projectors has been made available by the Hy-A-Log Co., 1028 E. 63rd St., Chicago 37, Ill. These charts are used for measuring radii on projected images with extreme accuracy. The measuring lines, being etched into the glass, are permanent. The charts enable an operator to check radii accurately, without computation. They are available in "mirror image" clear glass or "right image" optical ground glass.

Lincoln Award for Text-books on Machine and Structural Design

An award program to encourage the preparation and publication of text-books, one on machine design and another on structural design, for fabrication by all processes, including welding, has been announced by the James F. Lincoln Arc Welding Foundation, Cleveland, Ohio. The object of offering these awards is to substantially reduce the usual delay between process developments in industry and the treatment of these new developments in text-books. Thus, the principal effect of the plan will be to render a service to engineering colleges and to the industries who employ their graduates by making up-to-date information available in text-book form.

The Foundation plans to distribute, in all, $20,000 in awards for text-books covering machine and structural design. The competition is open to anyone in the teaching profession, in industry, or in consulting engineering practice. Manuscripts may be submitted jointly by two or more persons. There are three awards for the machine design text-book, of $5000, $3000, and $2000, respectively, and awards of the same amounts for the structural design text-book. In addition, the authors will receive royalties from any of their text-books that are published and sold in book form. The competition closes May 15, 1946. Further details can be obtained from the James F. Lincoln Arc Welding Foundation, Cleveland 1, Ohio.

* * *

Testing Equipment for Low-Voltage Circuits

A circuit tester known as the "Lo-Volt Test-Glo," intended for testing circuits from 5 to 50 volts, has been placed on the market by the Ideal Commutator Dresser Co., 1011 Park Ave., Sycamore, Ill. This equipment simplifies the testing of circuits, and can be used for indicating the relative value of line voltages. The incandescent glow lamp is protected by a transparent plastic housing. The over-all length is only 7 inches. The device is especially handy for automotive and aircraft mechanics and electricians.

Materials of Industry

THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

Continuous-Cast Bronze Rod for Automatic Screw Machines

Three continuous-cast bronzes in rod form—a tin bronze, Ampcoloy 742; a high-lead bronze, Ampcoloy 342; and a bearing bronze, Ampcoloy 382—have been made available to industry by Ampco Metal, Inc., Milwaukee 4, Wis. These bronzes have an extremely uniform structure, with lead or other secondary constituents uniformly dispersed and in a finely divided state throughout. Dirt, dross, and shrinkage cavities are excluded by the nature of the continuous casting process. These advantages are expected to result in practically eliminating scrap caused by metal faults and in more rapid production because of the adaptability of the continuous-cast rods to use in semi-automatic and fully automatic screw machines.

The rod is produced by the continuous withdrawal of metal from the bottom of a casting crucible. Upon leaving the crucible, the metal solidifies and then passes through a suitably cooled die. 201

Conolite—A New Plastic Laminate with Unusual Strength

A new plastic laminate, stronger and lighter than Duralumin, ordinarily used in manufacturing airplanes, has been developed by the Consolidated Vultee Aircraft Corporation, San Diego, Calif. The material is known as "Conolite," and is made by impregnating Fiberglas or Fortisan fabric with a new type of thermo-setting resin. Although still considered an experimental project by its originators, Conolite is already being used to fabricate parts of Liberator and Dominator bombers.

Most plastic laminates have a tendency to absorb moisture and deteriorate when subjected to salt water and various other liquids. Conolite specimens have been immersed in salt water, benzine, aromatic fuels, and acetone for periods ranging from twenty-four to forty-eight hours without signs of deterioration. Vibrations due to engine and propeller operations are a frequent cause of failure of airplane parts. Conolite parts have shown a high degree of freedom from all types of resonance, and, in fact, actually tend to deaden vibrations.

Because its tensile strength ranges up to 120,000 pounds per square inch, Conolite is in some respects comparable to steel, although its specific gravity is only 1.64. It may eventually be used to fabricate entire airframes. 202

Five New Synthetic Elastic Industrial Adhesives

Five types of cement and a calking compound, all of which consist of unvulcanized synthetic elastic compositions which can be vulcanized with heat or are self-vulcanizing at atmospheric temperatures, have been placed on the market by E. I. du Pont de Nemours & Co., Inc., Fabrikoid Division, Fairfield, Conn. All of these cements and the calking compound carry the trade name "Fairprene," and are designated as Type No. 1, Type No. 2, Type No. 3, No. 5105, No. 5106, and No. 5112.

The cements are used to obtain the adherence of various combinations of cured and uncured Neoprene stock, cured and uncured rubber, leather fabrics, and paper. They are also used in sheet-metal joints of aluminum and Dural preparatory to riveting, when fabricating fuel tanks and waterproof compartments; as binders for oil-resistant packings; as sealants for instrument installations; and as protective coatings on wire. They are being widely tested for use as corrosion-protective coatings for metallic surfaces. 203

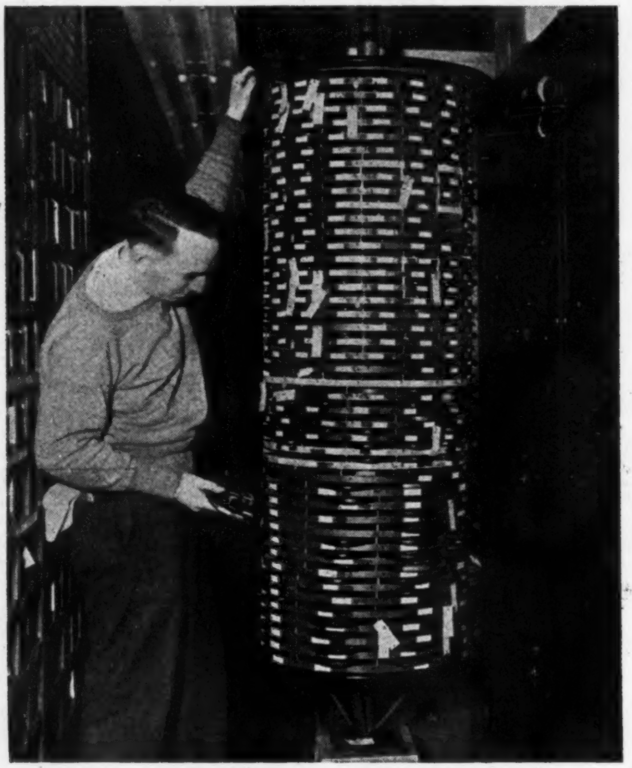
Waterproof Fillet Cement for Wood or Metal Patterns

A waterproof fillet cement for leather, wood, and plastic fillets on wood or metal patterns has been developed by the Kindt-Collins Co., 12651 Elmwood Ave., Cleveland, Ohio. Because of its simplicity of application, the new cement is said to save time and labor in the pattern shop. It is not affected by moisture or by the heat of the molding sand. Another advantage is that sand will not stick to the edges of a fillet on which it has been used.........................204

To obtain additional information about materials described on this page, see lower part of page 218.

Turntable Snap-Gage Rack

The turntable rack shown in the accompanying illustration provides storage for 400 snap gages at the Fort Edward plant of the General Electric Co. Since the gages are issued and returned daily, it is necessary to store them in an accessible position, at the same time using the minimum of floor and wall space. This rack, with shelves spaced to accommodate different thicknesses of snap gages, and with separators between the different gages, was devised by C. S. Loughlin of the plant's planning department. When a gage is removed, a tag is attached to the empty space in the rack. The entire rack is mounted on an iron pipe that passes through the center. The pipe rests on a ball bearing at the bottom and runs in a roller bearing at the top. Circular pipe rails, attached to the top and bottom shelves, facilitate the turning of the rack.



Convenient Turntable Rack for Storing Snap Gages

* * *

Attention has been called to the fact that Thomas A. Edison observed electronic effects in experimenting with incandescent electric lamps more than fifty years ago, but it took twenty years of experimentation to develop this observation into the invention of DeForest's first radio tube. Most great inventions have required much hard work and application to become of practical use.

Standards of Work Performance

In a recent issue of *Trundle Talks*, published by the Trundle Engineering Co., Cleveland, Ohio, George T. Trundle, Jr., emphasizes the importance of setting adequate standards of performance in our industrial plants. "We buy coffee by the pound, milk by the quart, transportation by the mile, and coal by the ton," says Mr. Trundle. "It is just as practicable to set up standards of performance with respect to the time it should take to do each operation in a machine shop.

"Standards in the factory are set on the basis of reasonable performance of an operation by a man with an average degree of skill, willing to do a fair day's work for a fair day's pay, and supplied by the management with the facilities which enable him to do this work to best advantage. How can anybody tell what the output of a plant reasonably ought to be unless there are some standards of this kind by which a reasonable output may be judged? Such standards must be predicated upon the assumption that the man performing the job has been properly trained, that he has the necessary materials and tools to work with when he needs them, that he has been given full instructions, and that the working conditions are satisfactory."

Our production problem today, serious as it may be, is not one of man-power, but of making the proper use of the man-power available. This can be done only through thorough cooperation between management, labor unions, labor, and the Government.

* * *

Band-Saw Bands

Rubber bands are a part of all band-saw equipment. They are applied to the face of the metal wheels over which the saw blade operates, serving as a cushion between the saw and the wheel. In this way, the "set" of the saw teeth is also protected. These bands, according to the B. F. Goodrich Co., are made from calendered sheets on drums in the form of sleeves, 15 to 18 inches wide, and then cut to the required width. The bands are purposely made shorter than the wheel circumference, since they are applied under tension in order to give them a tight fit.

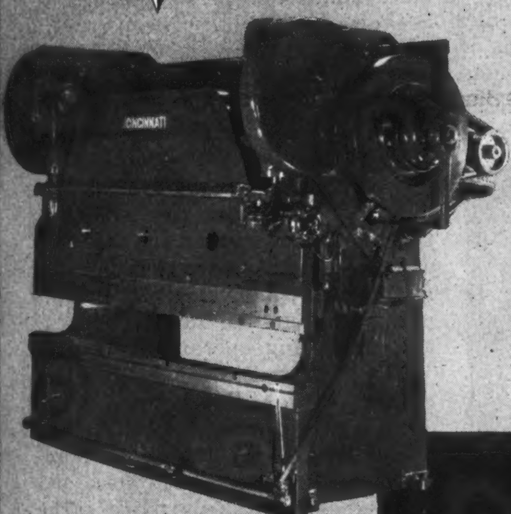
Some users prefer to use, in addition, a bonding medium to increase the tension between the rubber and the pulley. High-grade shellac and fish glue are among the most commonly used adhesives. Rubber cement can also be employed for the purpose. However, if proper allowance for stretch is made, the bands perform satisfactorily merely with the tension under which they are applied.

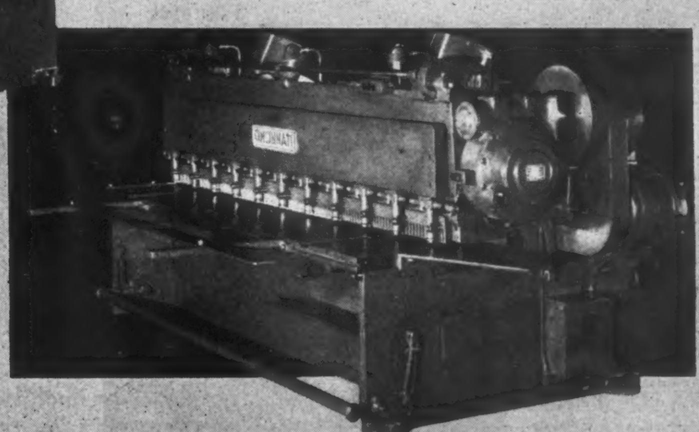
. . . . accurate shearing and accurate forming are a basic requirement.

Cincinnati Shears produce such accurate straight sided blanks that in many cases expensive blanking dies are eliminated. Cincinnati Press Brakes next notch and form the blank to the final accurate shape.

Together, Cincinnati Shears and Cincinnati Press Brakes are a profitable team for the production of the accurate parts that insure easy low cost assembly.

- Write for Shear Catalog S-4 and Press Brake Catalog B-2





THE CINCINNATI SHAPER CO.

CINCINNATI OHIO U.S.A.

SHAPERS · SHEARS · BRAKES

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Cincinnati Press Brake of Gigantic Size

The Cincinnati Shaper Co., Cincinnati, Ohio, has just built for the American Rolling Mill Co., Middletown, Ohio, what is believed to be the largest mechanical two-housing press brake in the world. This huge machine, shown in the accompanying illustration, has a clear span of 20 feet between housings and an over-all bending surface length of 30 feet. It is capable of exerting a pressure of 1000 tons, and is being used to make right-angle bends 20 feet in length in cold steel plate 3/4 inch thick.

The construction of this press brake is of unusual interest in that the four main members—that is, the bed, ram, and two housings—are made from what are said to be the largest rolled steel plates in the world. These plates were produced to meet the requirements for this special brake by the Lukens Steel Co., Coatesville, Pa. The total weight of this press is 250,000 pounds, or approximately 86,000 pounds more than the largest standard size Cincinnati press of this type, which has a clear distance between housings of 14 feet 6 inches, a total over-all die bending surface length of 18 feet, and a forming capacity of 1 inch by 12 feet. Like the standard machines of this type, which included more than forty different sizes, the huge machine illustrated can be equipped for a wide range of press brake operations.

Acute angle and flattening dies can be employed to form hems at the edges of large metal sheets, and there is a wide variety of dies available for making 90-degree bends and various forms of offset bends. Radius dies can also be furnished for making right-angle bends with a comparatively large radius and for making U-shaped bends.

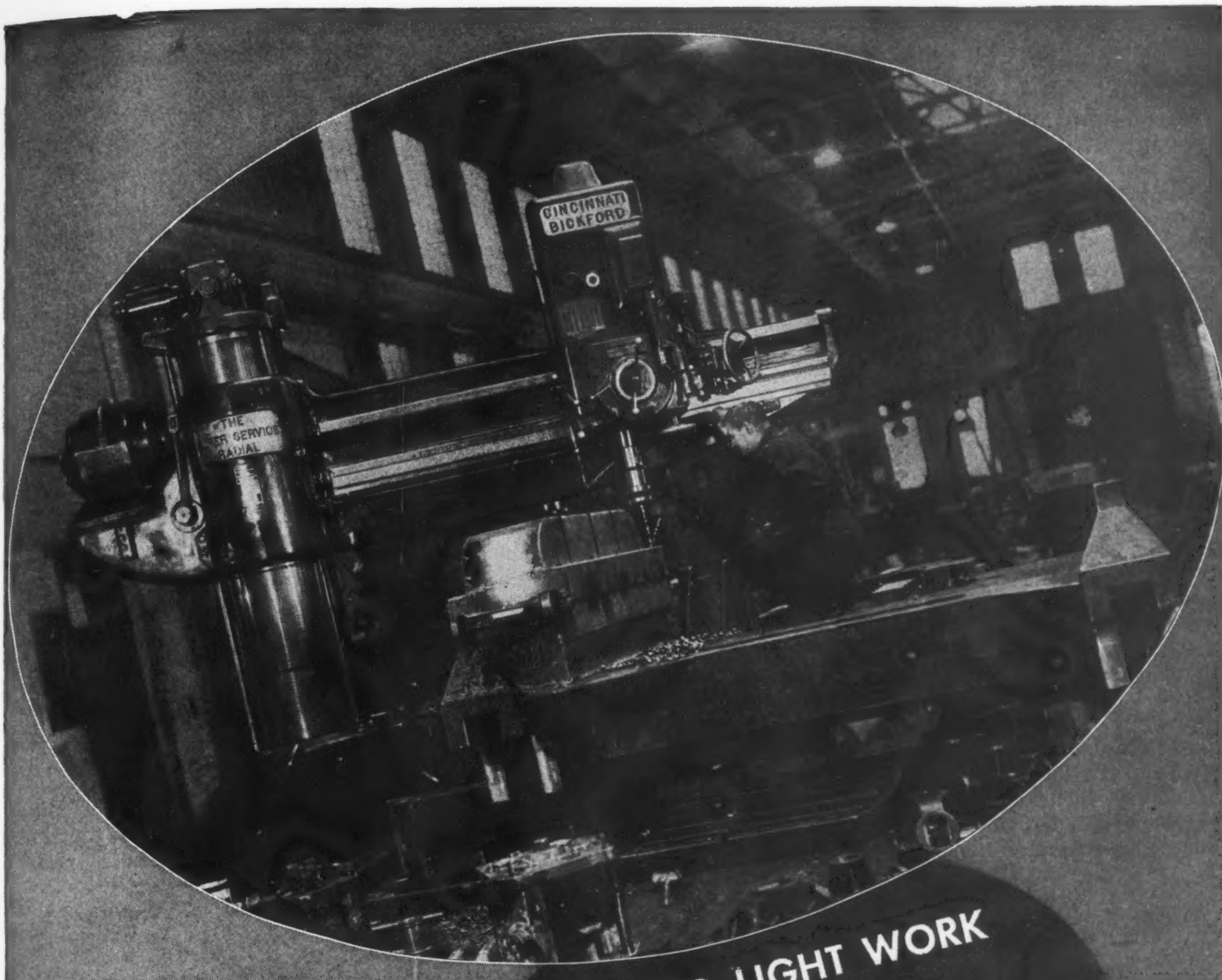
Cincinnati Press Brake Believed to be the Largest Machine of This Type ever Built

Dies for performing various beading and wiring operations can also be provided. Beading dies, for example, can be furnished for use in the manufacture of piano hinges. Seaming dies can be applied to the press for forming lock-seams of various types, such as are used to join metal sheets. Dies for forming round and square tubes and channels of various proportions are also available. The corrugating of flat sheets and the production of corrugated curved sections for fabrication into large corrugated tubing can be accomplished on this type of press when it is equipped with dies of the proper design. In addition to the various types of dies referred to, the press can be equipped with dies for performing a wide variety of punching, piercing, notching, trimming, and embossing operations.

The pressure, in tons, exerted by the press brake is shown directly on an indicator. This indicator is useful in making records for reruns or duplication of work and for experimental purposes. The dial of the indicator is marked with "Normal," "Caution," and "Danger" segments in white, amber, and red, respectively. The overload release on the machine can be set to disengage the clutch and stop the press brake at any predetermined overload.

The two-speed transmission gives a slow speed for special work, in addition to the normal top speed for regular production. Provision can be made for special variable and multiple speeds. The beds and rams can be extended at one end for the performance of closing or horning operations. 61

To obtain additional information on equipment described on this page, see lower part of page 218.


CINCINNATI
BICKFORD
THE
SUPER SERVICE
RADIAL

W. F. & John Barnes Vertical Drilling, Boring, and Facing Machine

A basic vertical machine, designated the 924, which can be equipped to handle a variety of high-production jobs requiring up to 60 H.P. and a thrust of 50,000 pounds has been developed by the W. F. & John Barnes Co., 320 S. Water St., Rockford, Ill. The design and construction features of this machine make it highly suitable for mass-production drilling, boring, facing, and reaming, especially on jobs requiring wide-area heads. Unusually low speeds are obtainable for heavy facing work by making simple adjustments on the hydraulic unit mounted on the side of the machine column.

The heavy cored column casting with 24-inch ways carries the head saddle and head, which are counterbalanced by easily accessible weights. The control bar, with adjustable dogs for governing the head travel, and the lubricator for the ways are mounted on the head saddle.

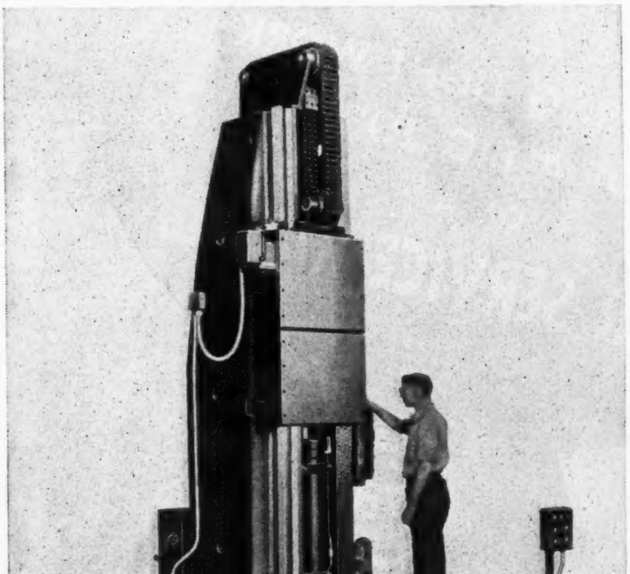
Typical adaptations of this machine include a three-station eighteen-spindle machine with a 60-inch hydraulically indexed table for reaming holes in airplane-engine crankcases; a twin-column machine for multiple drilling and reaming a 72 3/4-inch diameter steel plate mounted on an index-table; an eighteen-spindle four-station machine with tapping unit, which drills, reams, spot-faces, and taps tractor track links; a machine for finish-facing and line-boring armor-plate tank differential carriers; and a machine which is equipped with a multiple-spindle vertical head for rough- and finish-boring, counterboring, back-counterboring, and chamfering sleeve seats in a motor block. __62

Thomas Open-End Bar Shears

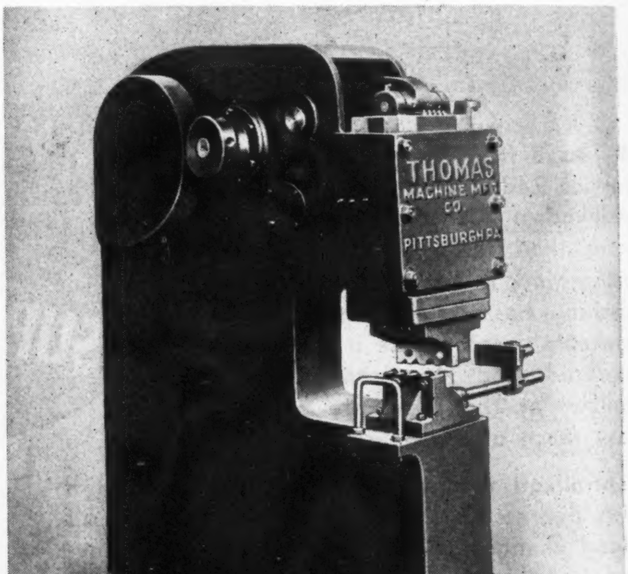
A new line of open-end vertical bar shears made in ten sizes, with rams capable of exerting pressures of 25 to 300 tons, has been placed on the market by the Thomas Machine Mfg. Co., Pittsburgh 23, Pa. The capacities of this line of machines for shearing round stock range from 1 to 3 inches in diameter. It is claimed that the open-end feature of these shears permits quicker and more accurate handling, and also allows a clearer view of the shear blades. Changing of the blades can also be accomplished more easily on the open-end type of shear.

These shears are adaptable for punching, as well as for plate and angle shearing. The ram is machined to facilitate attaching various types of punching tool equipment, including single, double, or triple units, cluster punches, or a floating punch.

The frames of the new machines are constructed of rolled steel plate, with heavy steel throat sections assembled by welding. The multiple jaw type clutch has a positive automatic kick-out for stopping the ram at the top of its stroke. The flywheel is mounted in roller bearings, located within the frame for safety and to eliminate overhanging loads on the bearings. The V-belt motor drive is designed to provide quiet operation of the shears and lessen the starting shock loads on the motor. ______63



Basic Vertical Machine Developed by W. F. & John Barnes Co. for a Wide Range of Production Drilling, Boring, and Facing Operations



Open-end Vertical Bar Shear Built by the Thomas Machine Mfg. Co., which can be Adapted for Punching, as well as for Plate and Angle Shearing

To obtain additional information on equipment described on this page, see lower part of page 218.

All-Purpose Punch Press

A new open-face type all-purpose punch press has been developed by the Maxant Button & Supply Co., 117 S. Morgan St., Chicago 7, Ill., to handle work that cannot be performed readily on any other type of press. This new press is adapted for a wide range of small punch-press work. Under actual operating conditions it is said to handle certain kinds of stamping, perforating, blanking, punching, piercing, light drawing, and forming at higher speeds than has been possible with previous types.

This machine can be employed for operations on metal, cloth, rubber, wood, synthetic materials, and plastics. It has a large cross-head of open construction which permits quick changing of dies, and the ram can be adjusted quickly for stroke length. The speed, or number of strokes per minute, can also be quickly adjusted.

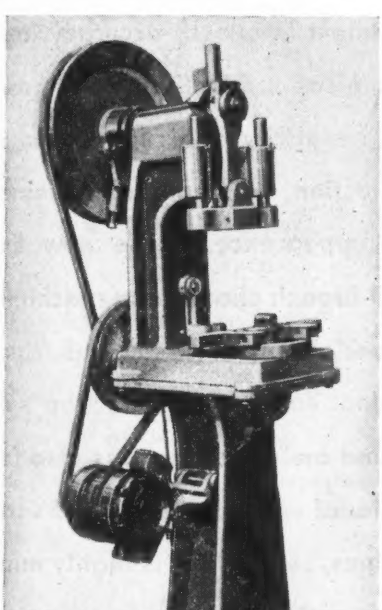
The slides can be furnished in various lengths to obtain the required workihg distance above the bed. The guide rods are lubricated by automatic wick oilers. The press is equipped with a positive clutch, and the flywheel is grooved for V-belt drive. The throat height of the press is 10 inches, and the depth 4 inches. The distance from the bed to the slide is 7 1/4 inches, and the area of the bed is 9 by 8 inches. The length of the stroke is 2 1/2 inches. 64

Landis Universal Grinder

The Landis Tool Co., Waynesboro, Pa., has developed a Type H 10- by 20-inch hydraulic universal grinder which is designed to meet the needs of industries requiring a fully universal machine that will turn out large quantities of small highly accurate parts in the toolroom or on the production line. The exact and sensitive controls with which this machine is equipped have been especially designed to make possible continuous production of close-tolerance work by operators of limited skill.

In general appearance, this grinder resembles the Landis 4- by 18-inch Type H plain machine, the major difference being in the universal wheel-head and the universal headstock with which the new machine is equipped. The bed is of the rigid box type design, with integral compartments for the coolant reservoir, controls, and hydraulic and electrical equipment. The bed is designed to eliminate headstock or footstock overhang at any position of the carriage. The vee and flat guides are constantly lubricated by a metered amount of filtered oil. This feature, together with full support of the carriage at all positions, tends to insure greater accuracy.

The headstock is driven by a constant - torque variable - voltage motor. This self-excited type of motor has a work-speed range of 90 to 600 R.P.M., and drives the headstock spindle through V-belts, arranged to eliminate vibration. Starting and stopping are controlled by a single lever. The headstock spindle and the work-drive pulley are mounted on preloaded super-precision ball bearings. Faceplate overhang is held to a minimum, and rigid support is provided for the work. The change from

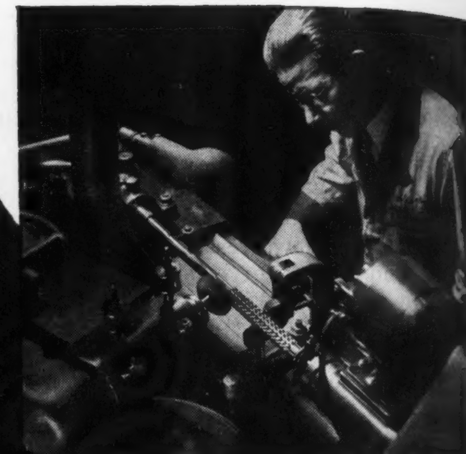


Open-face Punch Press Built by Maxant Button & Supply Co.

Universal Grinder Equipped with Sensitive Controls Brought out by the Landis Tool Co.

To obtain additional information on equipment described on this page, see lower part of page 218.

For the IMPORTANT work of sharpening broaches



Broach sharpening on Ex-Cell-O small broach sharpening machine, Style 80 (for round broaches).

MANY years of experience in the production of broaches, broaching fixtures, and precision machine tools form the background for the design and manufacture of Ex-Cell-O broach sharpening machines. Each machine is built to give the utmost in speed, accuracy, and economical production. Each combines simplicity and ruggedness in construction, with modern streamlined appearance. These new Ex-Cell-O broach sharpening machines are special purpose machines. They are ideal for large production set-ups, and are advantageous also for occasional work. By the use of such machines, set-up time is highly minimized, and the hazard in changing equipment is practically eliminated. ***See an Ex-Cell-O representative today.***

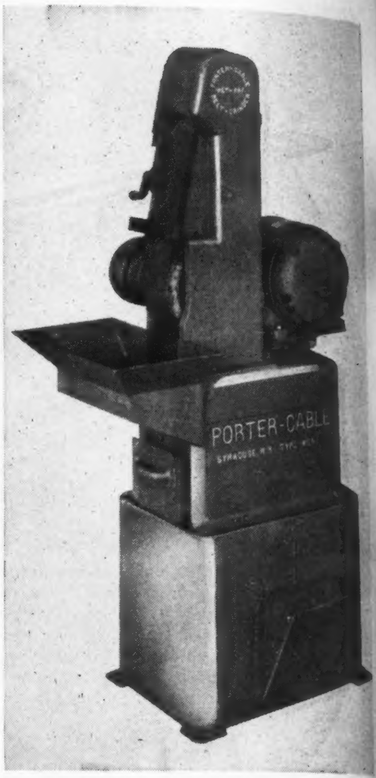
USE EX-CELL-O BROACH SHARPENING MACHINES

EX-CELL-O CORPORATION

live- to dead-spindle operation can be accomplished quickly and easily by means of a plunger. The head can be swiveled to any angle up to 90 degrees for performing face grinding operations.

The grinding wheel head is mounted on a sub-slide and swivel base; it can be swiveled 90 degrees either side of zero and can be moved 4 inches forward or back to obtain additional work clearance. All vee and flat guides and swiveling surfaces are lubricated by a "one shot" system. A 1-H.P., constant-speed, dynamically balanced motor drives the Landis Microsphere bearing grinding wheel spindle through V-belts.

The hydraulic system consists of a traverse cylinder, a direct-connected, motor-driven, vane type oil-pump, and control valves. A smooth, uniform carriage traverse speed of 3 to 120 inches per minute is available. The accuracy of the point of reversal in the carriage travel can be held to within 0.001 inch. 65

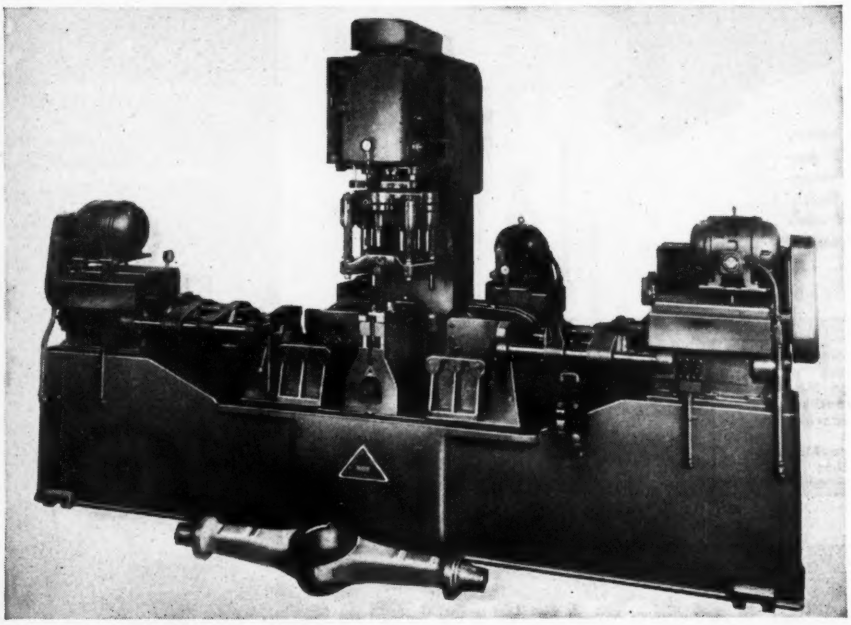


Wet Belt Surfacing Machine Developed by Porter-Cable Machine Co.

LeMaire Special Multiple-Unit Machine for Drilling Truck Axle

A special machine for drilling twenty-nine holes from four directions in a truck-axle mounting or carrier has been designed by the LeMaire Tool & Mfg. Co., 2657 S. Telegraph Road, Dearborn, Mich. Four standard LeMaire twin-ram hydraulic units have been combined to form this machine. Two units are located in horizontal positions at opposite ends of the long main base, from the middle of which an auxiliary base extends to the rear to accommodate the third horizontal unit. The fourth unit, which operates vertically, is mounted on a column that straddles the rear unit.

A cam-and-lever, quick-action, work-holding fixture is mounted in a convenient position for the operator. Brackets are provided to maintain accurate alignment. When this machine is in operation, the right and left heads each drill six 27/64-inch holes and one 1/2-inch hole; the rear head drills five 27/64-inch holes and one 21/64-inch hole; the vertical head drills eight 5/16-inch holes and one 27/64-inch hole. All twenty-nine holes are drilled simultaneously, at a production rate of 45 pieces per hour. 66



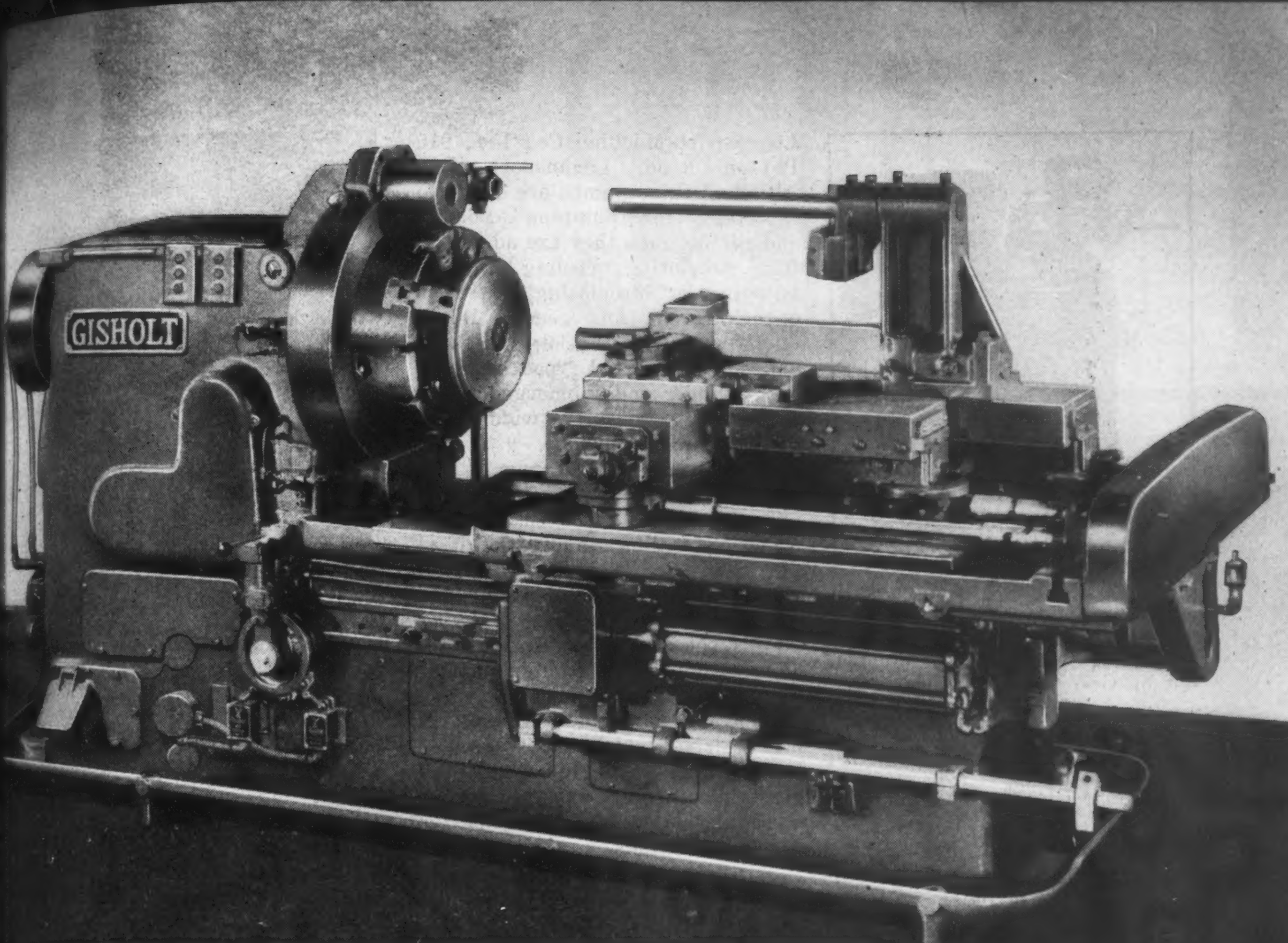
Special Machine Built by Le Maire Tool & Mfg. Co. for Drilling Twenty-nine Holes in Truck-axle Mounting Simultaneously

Porter-Cable Wet Belt Surfacing Machine

The advantages of wet abrasive-belt machining can be applied to line-contact grinding and polishing, as well as platen machining, in a new surfacer developed by the Porter-Cable Machine Co., Syracuse 8, N. Y. The resiliency of the contact roll of this machine permits the abrasive grains to cut or dig in and thus remove metal at a faster rate. The resiliency of the roll also tends to eliminate chatter, and the balancing of the abrasive belt and the contact roll facilitates more accurate control over the finish obtained.

An accurate platen is located immediately above the contact roll for convenience in grinding flat and square work after stock has been removed by the contact roll. Wet belt operation of the machine serves to eliminate the disadvantages of overheating, which may cause distortion, warping, checking, cracking, etc. It also eliminates dust, which is injurious to health and equipment. Cool operation is obtained by wet grinding, which serves to speed up the cutting action and prevent loading of the belt. The 4-inch abrasive belt has a large working area, and is driven by a 1 1/2-H.P. motor, which provides ample power. The machine is equipped with a self-contained circulating system and a motor-operated pump to supply the coolant for performing the wet grinding operations. 67

To obtain additional information on equipment described on this page, see lower part of page 218.


GISHOLT

Universal Chucking Grinder Brought out by Gear Grinding Machine Co.

Universal Chucking Grinder

The Gear Grinding Machine Co., 3901 Christopher, Detroit 11, Mich., has brought out a new "Geargrind" machine of the universal chucking grinder type, designed to handle both internal and external cylindrical grinding work. This machine can also be used for grinding internal and external conical surfaces, formed spherical surfaces, and formed annular surfaces, such as ball-bearing races and fillets. Combinations of these grinding operations can be performed in a single set-up to insure a high degree of accuracy and perfect blending of curved with straight surfaces.

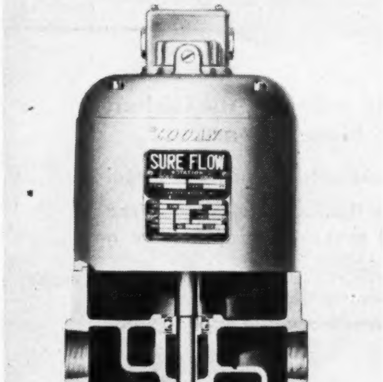
Features incorporated in the construction of this machine to insure accurate, fine finish and low production costs include heavy, vibration-free base; precision pre-loaded bearings for the vertical oscillating spindle, work-head spindle, and grinding wheel spindle; grinding spindles dynamically balanced; quick-acting clamping attachments for collets or diaphragm chucks; micrometer feed-screws for work-head set-up and grinding wheel spindle; and adjustable diamond wheel-truing device. 68

Logan "Sure-Flow" Pumps

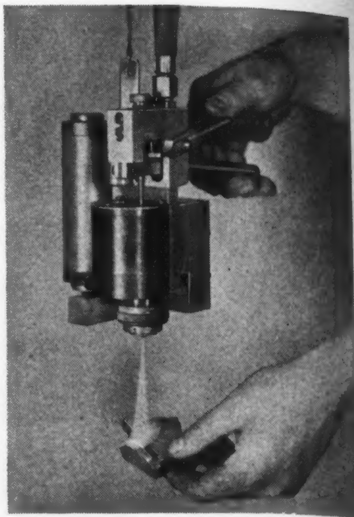
An improved line of centrifugal pumps, including twenty-seven different sizes and types, known as Logan "Sure-Flow" pumps, has been introduced to the trade by the Logansport Machine Co., Inc., 910 Payson Road, Logansport, Ind. Although these pumps are designed especially for pumping coolants and cutting oils, they are adaptable for circulating cooling liquids, pumping or circulating water or quenching oil, and general liquid transfer service. Foot-, bracket-, and flange-mounted types, together with grinder and submerged types, are available to suit a wide range of operating conditions.

A feature of these pumps designed to insure maximum pumping efficiency is the open type impeller, which eliminates the need for close clearances or metal-to-metal contact of running parts. This construction permits pumping liquids containing some abrasives, filings, and other foreign matter without damage to the pump. The pumps are equipped with integral motor drive, which allows greater latitude in locating them, since no gears, chains, or other forms of mechanical drive are necessary for such installations.

Self-priming without submerging is a feature of the base- and bracket-mounted models, which affords a high degree of flexibility in locating the pump in relation to the liquid to be handled. These two models can be installed at any convenient point above, below, or at some distance from the liquid. Self-priming without submerging is readily accomplished without resorting to the use of auxiliary priming reservoirs, check-valves, or other accessory equipment. 69



Impeller Type "Sure-Flow" Pump Made by Logansport Machine Co.



Self-contained Low-temperature Metal "Alloy-Sprayer"

Low-Temperature Metal "Alloy-Sprayer"

A self-contained "Alloy-Sprayer," designed and built especially for the precision spraying of low-temperature metals and alloys, has been added to the line of metal atomizers made by the Alloy-Sprayer Co., 602 First National Bldg., Ann Arbor, Mich. This new sprayer is being used extensively for the production spraying of selenium rectifier cells and disks, and for applying a protective coating to wood patterns and similar work. It is especially adapted for use in laboratory research work because of the close control of the characteristics of the spray.

Although the new Model FP is designed primarily for spraying vertically downward while suspended on a chain or similar support, it can be swung upward to spray almost in a horizontal direction. Thus it can be used for almost any type of spraying, either as a production or laboratory instrument.

The sprayer is designed to give instant control over the quality of the spray. The application of alloy or metal can be made in three stages—designated as "fine spray," "coarse spray," and "pour." The degree of fineness or coarseness of spray in each stage can be varied by means of an adjustable needle valve. Both stages of spray are accomplished with the air pressure on, while "pouring" is done with the air pressure cut off.

With this sprayer, metal or alloy can be added without interrupting

To obtain additional information on equipment described on this page, see lower part of page 218.

the spraying operation. The metal can be added intermittently, as required. The metal or alloy, in almost any form, is melted in the pot preparatory to spraying by means of thermostatically controlled electrical elements, the operating range being from 100 to 600 degrees F. Operating air pressures range from 20 to 60 pounds per square inch, depending on the requirements of the job. 70

"Di-Acro" Hand-Operated Radius Brake for Forming Aircraft Materials

The O'Neil-Irwin Mfg. Co., 332 Eighth Ave. S., Minneapolis 15, Minn., has developed a radius brake designed to meet the requirements of aircraft manufacturers for a precision machine capable of properly forming duralumin, chrome-molybdenum, rust-resistant, and spring-tempered alloys, and various other low ductile materials that are essential in the fabrication and production of aircraft. This precision radius brake is designed to entirely eliminate the possibility of fracture or disintegration at the forming line while working these materials. The radii obtainable with this unit are in accordance with the predetermined standards recommended for aircraft construction, the maximum folding angle being 110 degrees.

Casehardened and spring-tempered materials that must be formed after heat-treating can also be safely formed to accurate dimensions. The extreme flexibility of the brake makes it exceptionally well adapted for testing and determining ductile qualities of a wide variety of alloy materials. It is also adaptable for a wide range of laboratory and experimental research work preparatory to the selection of proper materials and the development of designs for experimental or finished working models.

Duplicate work handled on this brake can be held to a tolerance of 0.001 inch, and can be formed to 1/16, 3/32, 1/8, 5/32, or 3/16 inch radius with standard forming plates. The machine has a maximum folding width of 12 inches, and a maximum full-width folding capacity for 16-gage steel plate. Plate of heavier gages but of narrower widths or more ductile materials can be handled. 71

Clark Master Diamond Checking Set for Hardness Testing Equipment

Master Diamond Checking Set for Hardness Testing Equipment

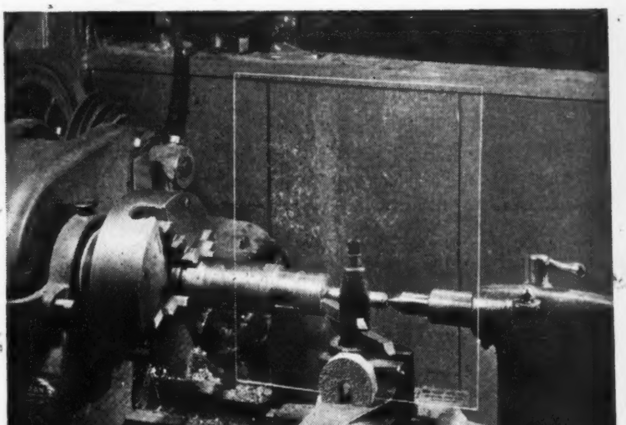
A master diamond checking set for checking the accuracy of hardness testing equipment has been placed on the market by Clark Instrument, Inc., 10200 Ford Road, Dearborn, Mich. This checking set can be used on all Clark and other hardness testing instruments employed for Rockwell testing. The set consists of a gold-plated diamond penetrator and two test blocks. The penetrator is made to exceedingly close tolerances, in order to give the highly accurate measurements required for checking readings. Since it is designed to be employed only for checking purposes, it retains its original accuracy for a long period of time. In checking, the master diamond penetrator replaces the regular penetrator in the machine.

The two master test blocks are also held to extremely close limits. They are used only in connection with the master diamond. The resulting combination furnishes a very accurate check of the machine, either as a periodical measure or whenever readings may be in doubt. 72

Safety Shield with Magnetic Mounting Base

A new safety device, designed to eliminate the need of goggles and face shields in many machine tool operations, has been brought out by the Dilley Mfg. Co., 10123 Euclid Ave., Cleveland 6, Ohio.

Hand-operated Radius Brake Developed by the O'Neil-Irwin Mfg. Co.



"Magnetic Grip-Shield" Mounted on Lathe to Protect Operator

To obtain additional information on equipment described on this page, see lower part of page 218.

JET PROPULSION

ANOTHER USE FOR "A·Q" GEARS

AIRCRAFT QUALITY

*O*N *THE DRAFTING BOARDS* of America's aircraft engineers are tomorrow's airplanes—planes that will bring New York City a little more than an hour away from Chicago—London five brief hours from New York. One of the advances that make these high speeds possible is the development of jet propulsion engines.

Still experimental in many phases, jet propulsion engines are today powering fighting ships on the European front. These engines offered many technical problems to designers, not the least of which was the gears. Because of the exacting demands of precision, light weight and high speed, it was natural for builders to look to Foote Bros. for the solution of this tough problem in gear design and production.

The jet propulsion engine is another example of how "A-Q" gears can aid technological development. These gears may well offer a successful solution to production problems you face on machines and equipment which you are manufacturing or planning to manufacture. Foote Bros.' engineers will gladly discuss with you the problem of producing gears to assure you greater mechanical efficiency, lighter weight, higher speed, greater quietness.

FOOTE BROS. GEAR AND MACHINE CORPORATION
Dept. P, 5225 S. Western Blvd. • Chicago 9, Illinois

A copy of this informative product engineering manual on "A-Q" gears will be sent to you on request as soon as it is ready.

FOOTE BROS.

Better Power Transmission Through Better Gears

This unique device, known as the "Magnetic Grip-Shield," consists of thick, transparent sheets of plastic, anchored in a permanent horseshoe magnet base. It is made in various sizes, and can be instantly mounted in the desired position on the machine without using tools.

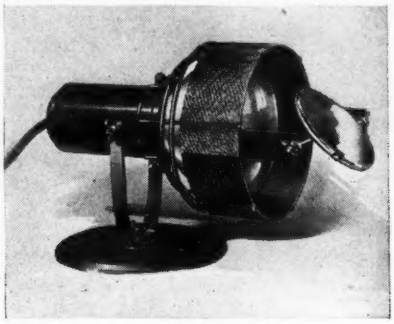
The magnet in the base of the shield holds it in position, yet with a slight twist, the shield may be moved to suit operating conditions. It deflects flying chips, metal dust, sparks, oil, and liquids, and protects the machine operator without obstructing his vision. It can be used on all types of machinery, such as lathes, grinders, drill presses, milling machines, buffing and sanding machines, woodworking machines, or any other types of equipment where protection from flying chips or particles is needed. The shield is made in sizes ranging from 3 by 4 inches to 8 by 10 inches. It also comes in a hood type designed for long-run operations. 73

Simmons "Spring Lock" Fastener

A new one-piece fastener assembly for use in securing panels, covers, and parts on equipment for automobiles, ships, refrigerators, radio sets, etc., has been developed by the Simmons Fastener Division of the Simmons Machine Tool Corporation, 1600 N. Broadway, Albany 1, N. Y. This fastener, known as the "Spring Lock," requires no lock washers or nuts. It will not work loose from vibration, and permanent installation in outer sheets prevents loss of the fastener when panels are removed.

"Spring Lock" One-piece Fastener Assembly for Securing Panels, Covers, and Other Parts

The inexpensive, single-piece construction of the fastener can be seen from the accompanying illustration. It is self-adjusting to compensate for various material thicknesses within the range of the fastener, and locks and unlocks with a quarter or 90-degree turn in a clockwise direction, or can be permanently installed for use as a blind rivet. The unique construction of the head assures one-direction rotation for locking or unlocking. A quarter-turn puts the initial twist in the spring, and another quarter-turn locks the fastener in place. Spring pressure pulls the sheets together, providing a tight, vibration-proof installation and high initial load without deflection. 74

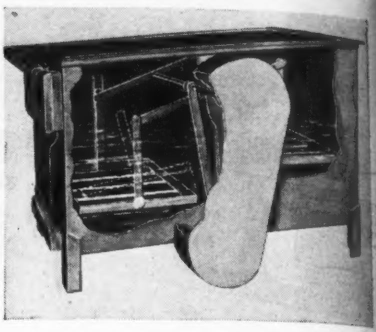


Lamp and Mirror for Inspecting Interior Surfaces

McGill Lamp and Mirror for Inspecting Interior Surfaces

The McGill Mfg. Co., Inc., Valparaiso, Ind., has placed on the market a No. 7500 inside inspector lamp having a mirror designed to facilitate close inspection of the inner surfaces of shells, tubes, castings, cavities, and the finished surfaces of various products.

This lamp throws a strong light inside the cavity to be inspected, and the operator simply adjusts the mirror to a point where he can see the interior surface clearly without assuming an uncomfortable position. The lamp has a 100-watt, 120-volt rating, and is supplied with a No. R-40 spotlight, installed complete with an adjustable mirror, 12-foot insulated cord and plug, and adjustable wing-nuts, which permit tilting the light and adjusting the mirror. 75



Metal-cleaning Washer Developed by Phillips Mfg. Co.

Two-Stage Surge Type Metal-Cleaning Washer

The Phillips Mfg. Co., 3475 Touhy Ave., Chicago 45, Ill., has recently developed a washer designed to provide an economical means for cleaning small parts contained in baskets, using an emulsion cleaner or an alkali cleaner and a water rinse. This cleaner has two compartments with an insulated wall between them. One compartment contains the cleaner, and the other the water rinse. A reciprocating mechanism moves the racks and baskets up and down through the cleaner and rinse. Two baskets are used at a time, one being swished through the cleaner while the second is being similarly treated in the rinse.

The reciprocating mechanism moves the baskets vertically through the solutions producing maximum agitation of the baths as required for efficient removal of chips, dirt, and other foreign substances. Either surge platform will accommodate basket loads of fifty pounds, operated singly or together. The machine is 40 inches long by 21 inches wide. Each tank holds 16 1/2 gallons of solvent or water, and each surge platform takes baskets 14 inches square by 6 inches high.

The reciprocating mechanism is driven by a 1/3-H.P. motor. The washer is available in four models —unheated; with heated solvent tank; with heated rinse tank; and with both tanks heated. The heated tanks are provided with automatic thermostatic controls, which keep the temperature of the solution uniform within plus or minus 5 degrees F. The water rinse tank is supplied with means for taking care of overflow, and can be fitted with a flow control valve. 76

To obtain additional information on equipment described on this page, see lower part of page 218.

SUNOCO EMULSIFYING CUTTING OIL

helps drills cut free and clean...prolongs drill life

Drills that hold their edges cut clean, cut fast, cut accurately and keep production moving. That's why leading metal working plants use Sunoco Emulsifying Cutting Oil to keep drills pointed for production.

Long drill life is what makes such manufacturers as the American Tool Works Company choose, use and recommend Sunoco Emulsifying Cutting Oil. In the photo above is an American 5'-15" Column Hole Wizard Radial Drill. A 3½" hole is being drilled in SAE 1020 cast steel at a speed of 83 RPM and a feed of .018"

Outstanding cooling and lubrication properties of the mixture of 1 part Sunoco and 20 parts water effectively protects the point of the drill. The drill clears easily, does not clog, chatter or burn. Drills last longer and the work is accurately finished with a fine surface.

Whatever the operation . . . drilling, reaming, boring, turning or milling, Sunoco Emulsifying Cutting Oil can help speed production in your plant. Get the details on how others have benefited with Sunoco. Write for your free copy of "Cutting and Grinding Facts" to . . .

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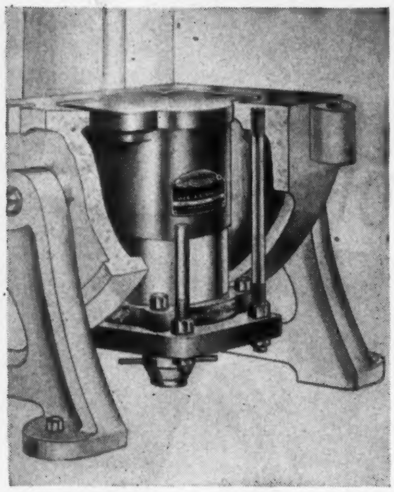
SUNOCO

SUN INDUSTRIAL PRODUCTS

OILS FOR AMERICAN INDUSTRY



Dayton Rogers Hydro-pneumatic Die Cushion

Dayton Rogers Hydro-Pneumatic Die Cushions

The Dayton Rogers Mfg. Co., 2835 Twelfth Ave. S., Minneapolis 7, Minn., has brought out a hydro-pneumatic die cushion that is designed to provide practically any ring-holding pressure in the limited press bed opening with a minimum over-all die cushion height. The pressures required are obtained by the application of a combination of pneumatic and hydraulic operating principles in the design of the die cushion.

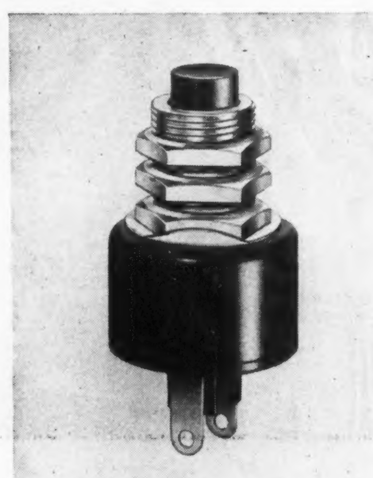
Basically, the die cushion unit is of the design commonly used on pneumatic applications, except that the entire cushion cylinder unit is filled with oil instead of air. The fluid is retained in the die-cushion cylinder and its piston, and is checked or held in suspension at a predetermined pressure by a combination relief and check valve. The pressure on the check valve is increased or decreased by regulating the air pressure against a pressure valve piston through a reducing regulator valve. The maximum ring-holding pressure developed by the pin pressure pad can be increased or decreased by varying the size of the relief-valve pressure piston. 77

Grayhill Snap-Action Switch

A small "momentary" push-button snap-action switch, designated "Snapit," has been announced to the trade by Grayhill, 1 N. Pulaski Road, Chicago 24, Ill. The phenolic body of this switch is only 7/8 inch in diameter and 1 7/8 inches high, measured from the top of the push-button to the end of the soldering lugs. The switch is mounted by means of a 3/8-32 bushing, 7/16 inch long, and is held in place by two mounting nuts.

The fixed contacts of the switch are of fine silver overlay on phosphor-bronze. The contact gap is 0.040 inch on each contact, making the total contact gap which breaks the circuit 0.080 inch. The contact pressure of approximately 35 grams makes it possible to use the switch for direct current.

The switch operates with a 0.0625-inch movement of the push-button. The current rating is 10 amperes at 115 volts alternating current, and 2 amperes at 115 volts direct current. The normally open single-pole type switch has a red push-button, and the normally closed single-pole switch has a black push-button. 78



Grayhill Small Snap-action Switch

Zephyr Flexible-Shaft Angle Drills

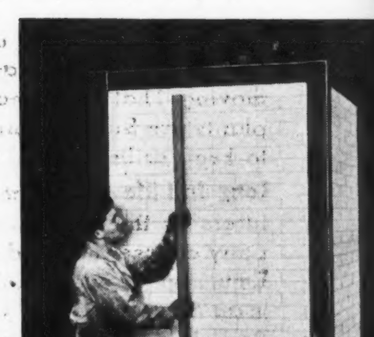
A complete line of flexible-shaft angle drills, including both 18- and 30-inch flexible shafts coupled to 45-, 90-, or 360-degree angle drills, is being offered to the trade by the Zephyr Mfg. Co., Inglewood, Calif. The flexible shafts can be supplied without the drills for coupling to other angle drills or with a threaded spindle for use without an angle drill.

These flexible shafts have a piano-wire stress-relieved core, encased in oil-resistant rubber and fitted with oilless type bronze bearings. The drill heads are made to close standards, and are equipped with heavy-duty bevel gears and ball and needle bearings. 79

Vertical Furnace for Heat-Treating Long Broaches

A new internally heated salt bath furnace designed especially for heat-treating long broaches and similar work in a vertical position has been developed by Upton Electric Furnace Division, 7450 Melville at Green, Detroit 17, Mich. The great depth of this furnace in proportion to the surface area of the bath is made possible by the new type of heating electrodes employed. These electrodes enter the furnace from the sides and at the bottom of the bath area of the furnace pot. They do not enter the working area of the bath, however, and therefore do not interfere with the work being treated. The working area of the bath is 81 inches deep by 9 inches square.

The furnace is equipped with two thermo-couples, one at the top and the other at the bottom of the pot, which record the temperature and actuate the "on" and "off" controller. Although a difference of 4 degrees temperature at the bottom of the bath actuates the "on" and "off" controller, the top

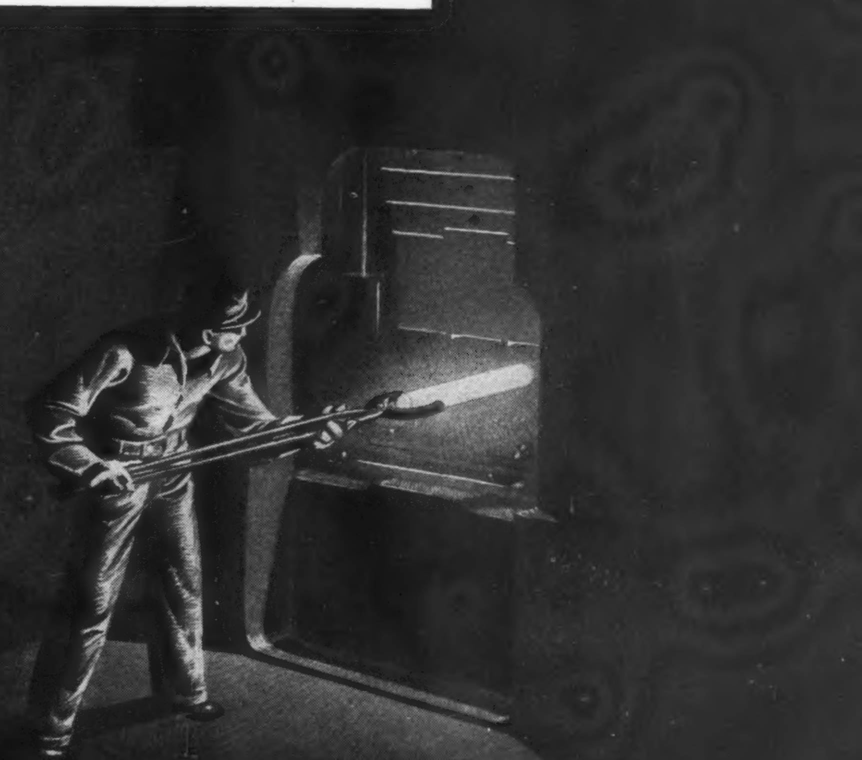


Vertical Salt Bath Furnace for Heat-treating Long Broaches

To obtain additional information on equipment described on this page, see lower part of page 218.

J&L HOT ROLLED BARS

Made from J&L Controlled Quality Steel for forging, machining, stamping, and many other uses. Available in round, hexagon, square, and flat sections, also special shapes and die-rolled sections. All J&L Hot Rolled Bars conform to exacting standards for accuracy and finish.



J&L STEEL

JONES & LAUGHLIN STEEL CORPORATION

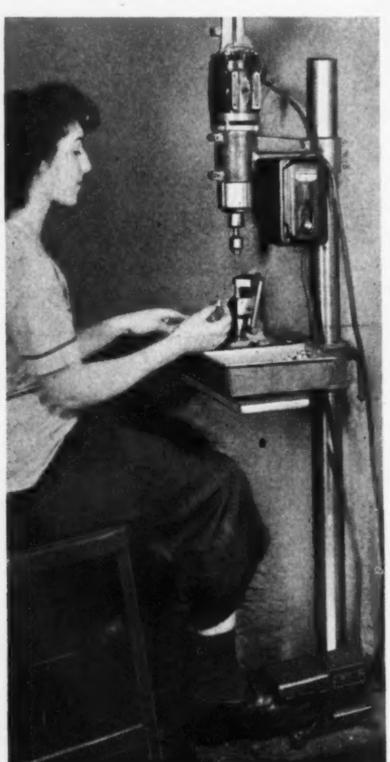
PITTSBURGH 30, PENNSYLVANIA

of the bath remains at a practically constant temperature. When long pieces of cold work are introduced into the bath, there is a uniform drop in temperature. 80

Automatic Drill Press Attachment

The Automatic Drill Press Co., 14899 Lesure Ave., Detroit 27, Mich., has just announced the development of an automatic drill press attachment with a capacity for using drills from No. 55 to 1/4 inch in diameter. The illustration shows the attachment as used for drilling two 3/32-inch diameter holes in a fuse part for a mortar shell. These holes are held to close depth tolerances.

The operator's hands are free to index the jig, load, and unload the part. The forward and reverse movement of the drill spindle is entirely automatic and is actuated by the foot-switch, which closes the motor circuit contact. All belts, gears, etc., have been eliminated, and the drill spindle is directly connected to the motor. The unit can be clamped to any standard drill press column. 81

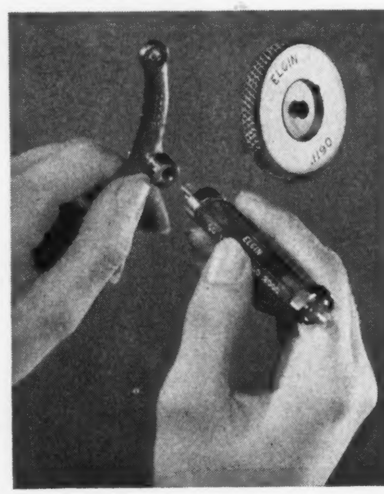


Automatic Drill Press Attachment Designed to Increase Production and Lessen Operator Fatigue

Elgin Sapphire Plug and Ring Gages

Exceptional resistance to wear is the outstanding characteristic claimed for the new sapphire plug and ring gages brought out by the Sapphire Products Division of the Elgin National Watch Co., 932 Benton St., Aurora, Ill. These gages are said to outlast by hundreds of times gages made from the hardest materials previously employed.

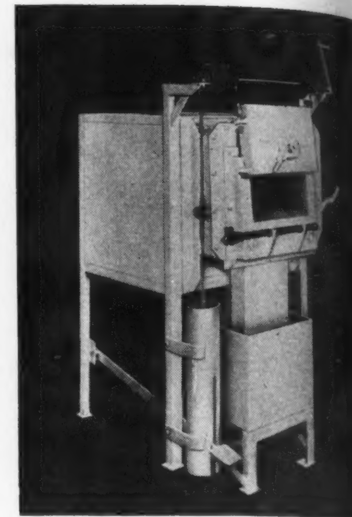
The extreme hardness of the sapphire—next to the diamond on the mineral hardness scale—gives



Sapphire Plug and Ring Gages Made by Sapphire Products Division of the Elgin National Watch Co.

the plug and ring gages made from this mineral their almost unbelievable wearing qualities. This resistance to wear makes it possible to order gages of the exact size needed without any allowance for wear. Sapphire gages also have the advantage of not being affected by any chemical ordinarily encountered in gaging. They are remarkably strong, and stand up well under the shocks received in ordinary use.

One of these gages in actual use at the plant of a well-known manufacturer showed no wear after gaging 80,000 parts; and after gaging approximately 158,000 parts the wear was hardly appreciable, being only about 0.00001 inch, or well within the specified tolerances. Before using a sapphire plug gage for this work, the company had been able to gage only 300 parts with any of the gages previously available. 82



"Kleenmetal" Furnace Developed by W. S. Rockwell Co.

Rockwell "Kleenmetal" Furnaces

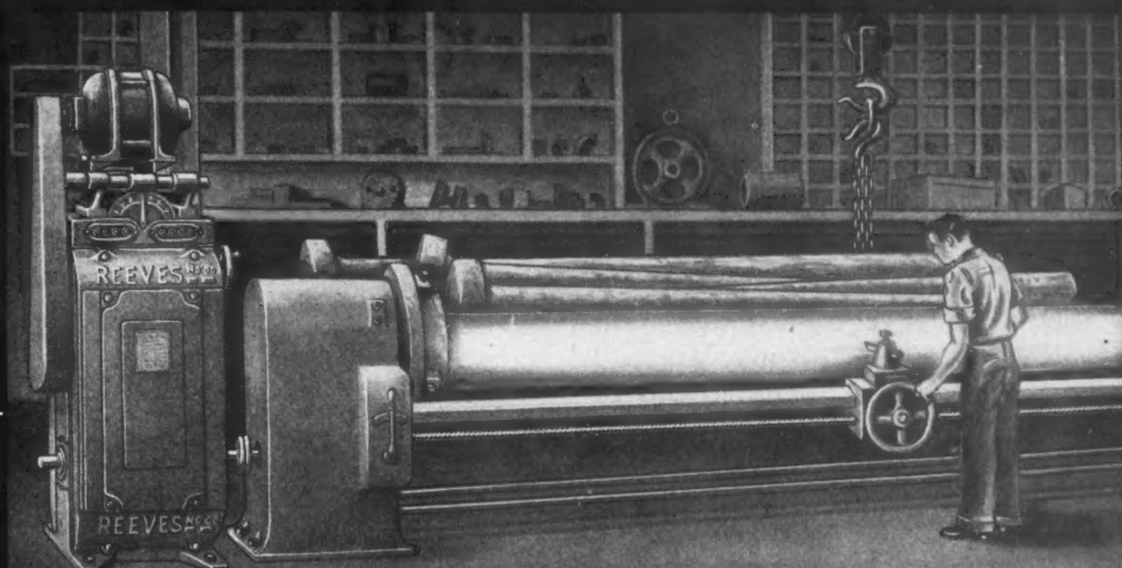
The W. S. Rockwell Co., 50 Church St., New York 7, N. Y., has recently developed a line of "Kleenmetal" oven type, protective-atmosphere furnaces to meet the requirements of tool-rooms and experimental departments. These furnaces are designed to give work a bright, clean surface finish in moderate-size batches, when heated within the range of 1200 to 2400 degrees F. They are adapted for such operations as bright annealing, silver or copper brazing, tool hardening, high-speed steel hardening, scale-free hardening, non-decarburizing heating, and the sintering of powdered metals.

The furnaces are insulated and reinforced, and are made in two types—those with carborundum or alloy muffles and those that employ direct heating. The muffle furnaces can be gas- or oil-fired, while the direct-heated furnaces can be gas- or electric-heated. Both types are supplied with a means of introducing prepared atmosphere gas from separate generators or cylinders.

For hardening and certain other heating operations, the long preheating chamber is provided with a chute leading to a quench tank set in front of the furnace. For bright or clean annealing, brazing, sintering, etc., both muffle and direct-heated furnaces are equipped with a water-jacketed chamber for cooling the work in the protective atmosphere.

To obtain additional information on equipment described on this page, see lower part of page 218.

STEPS UP PRODUCTION



40-Hour Job Cut to 23 Hours by Applying Reeves Variable Speed Transmission to Lathe in Operation from 19 to 24 Hrs. Daily for 2 Years

• Typical of the ingenuity and "know how" which made America "The Arsenal of The Democracies" is the story about two small West Coast machine shops.

To machine the huge propeller shafts for Liberty ships, so urgently needed in the Pacific War, every possible facility was pressed into service. These shafts were from 13" to 20" in diameter, and from 17 to 22 feet long. They were too large for lathes ordinarily found on the West Coast, but this did not stop the shop owners.

The first shop converted a big old belt-driven lathe to provide modern controlled speed operation, with a large REEVES Variable Speed Transmission. Production was stepped up from one completed shaft every 40 hours, to one finished every 23 hours.

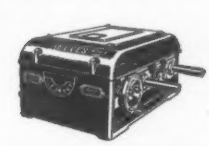
The ingenuity of the other shop proprietor was equally interesting. He built his own lathes out of concrete and old automotive parts, and with controlled speed provided by REEVES transmissions, is turning out finished shafts in greatly increased numbers.

In both of these applications REEVES Speed Control made possible the maximum peripheral cutting speed at every stage of the processing of these lathes.

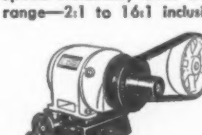
Here again, the adaptability, accuracy and rugged strength of REEVES Speed Control contribute to the war effort. Write for copy of 96-page Catalog M-450.

REEVES PULLEY COMPANY • COLUMBUS, INDIANA

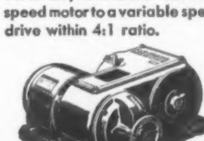
THE 3 BASIC REEVES UNITS



VARIABLE SPEED TRANSMISSION for providing infinite, accurate speed flexibility over wide range—2:1 to 16:1 inclusive.



VARI-SPEED MOTOR PULLEY converts any standard constant speed motor to a variable speed drive within 4:1 ratio.



MOTODRIVE combines motor, speed varying mechanism and reduction gears in single unit, speed ratios 2:1 to 6:1 inclusive.

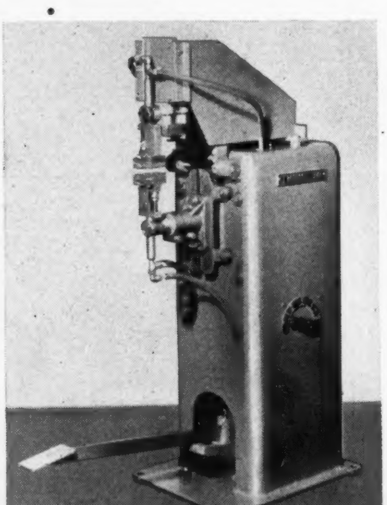
REEVES *Accurate Variable* SPEED CONTROL

The heavy self-sealing door is provided with a smaller swing type door with a window for observation of work and for loading or removing small pieces from the furnace without exposing a large area of the furnace to the atmosphere. Under the charging door and also under the discharging door of the cooling section there is a gas burner which provides a flame curtain that prevents air infiltration. Furnaces with or without a discharge chute are built with hearth areas of 8 by 12, 12 by 16, and 16 by 24 inches. Furnaces with cooling chambers are built in five sizes with hearths ranging in size from 8 by 14 to 27 by 36 inches. 83

Spot-Welder Equipped for Wire-Cable Cutting, Welding, and Shaping

The Thomson Model C 15-kilovolt-ampere spot-welder, made by the Thomson-Gibb Electric Welding Co., Lynn, Mass., is equipped with special clamping dies and a special head for straight-line vertical action, which not only cuts off electric wire cable, but also shapes the strands and welds them together at the ends.

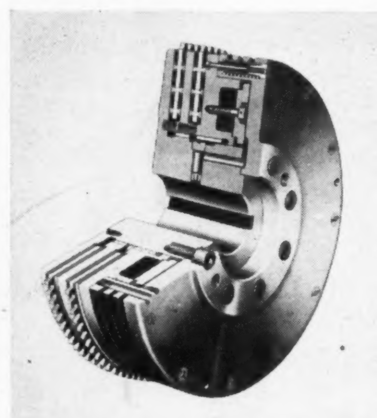
As the upper head of the welder descends, the cable is clamped and held firmly by the stationary half of the dies, while the other half continues to move downward, stretching the cable. The welding current is applied, and all the cable strands are welded together the instant the cable is parted by being stretched to the breaking point. With this equipment, the cable is not only cut off, but the ends of the wires are welded and flattened to the desired shape. 84



Thomson-Gibb Wire-cable Cutting, Welding, and Shaping Machine

Air-Actuated Twin-Disc Clutch

The Twin Disc Clutch Co., Racine, Wis., has brought out a new air-actuated clutch, known as the Twin Disc Model P, which is especially designed for remote control set-ups and for use when "feather touch" engagements in heavy-duty operations are necessary. This new product retains many of the features of the heavy-duty Twin Disc Model E friction clutch, and can be used in many of the same types of installations.



Cut-away View of Air-actuated Twin-Disc Clutch

The Model P clutch has a hub and back plate, center plate, floating plate, and friction discs of essentially the same proportions as Model E, and is manufactured in a wide range of sizes from 14 to 36 inches, and in capacities of 65 to 895 H.P.

The air-actuated clutch operates by remote control on any air pressure ordinarily available, the friction plates making provision for either slow or fast engagement. Air can be delivered to the clutch by two different methods, depending upon the manner in which the clutch is mounted. In one method, the shaft is drilled and a rotary air seal employed, while in the other method, a special "shaft-around" or a mid-shaft rotary air seal is employed. 85

Size-blocks Made for Shop Use by Yankee Precision Products Co.

Carbide-Tipped Size-Blocks for Shop Use

The Yankee Precision Products Co., 965 Farmington Ave., West Hartford 7, Conn., has brought out a new type of size-blocks, termed "Handi-Blox," which are designed for everyday use in the shop and on the production line. These blocks are available in sizes from 0.250 inch up to 4 inches for measuring in steps or increments of 0.0625 inch. The smaller sizes —up to 5/8 inch—are made of solid carbide, while the larger sized blocks have carbide-faced ends.

The Handi-Blox are accurate within 0.0001 inch. They are not intended to take the place of precision gage-blocks, but rather to be used in the shop wherever possible to save the wear and tear on precision gage-blocks. 86

Self-Locking "Driv-Lok" Vibration-Proof Pins

A line of standard and special self-anchoring, vibration-proof pins designed to replace more expensive taper pins, keys, cotter-pins, rivets, etc., has been brought out by the Driv-Lok Pin Co., 565 W. Washington Blvd., Chicago 6, Ill. These pins are pressed or driven into the drilled holes. They have four flutes on the surface, parallel to the axis. The raised, work-hardened edges of these flutes provide an expanded diameter, a few thousandths inch greater than the nominal diameter of the pin.

When the pin is inserted in a drilled hole, these raised edges are compressed inward, providing a resilient, self-locking element, which, it is claimed, will hold firmly

To obtain additional information on equipment described on this page, see lower part of page 218.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It's the new bond that gives the ultra smooth finishes you get with Chicago Grinding Wheels—
Precision finishes undreamed of before—
Finishes so accurate that you can measure them in micro inches with a Surface Analyzer.
Whatever you have to finish—metals, alloys, plastics, wood, laminates or composition materials—you can do it better with Chicago Wheels.
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CHICAGO GRINDING WHEELS
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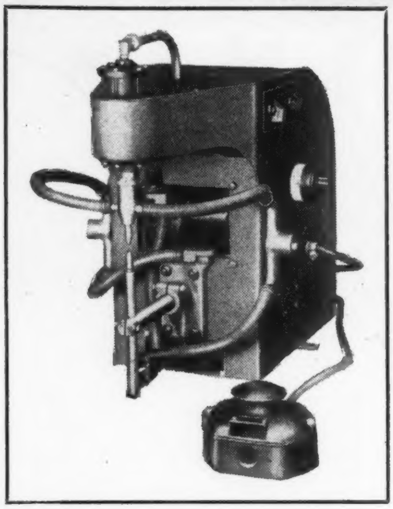
against the effect of vibration or shock. These pins are available in sizes ranging from 3/64 to 1/2 inch in diameter and from 3/16 to 4 1/2 inches in length. In the past, these pins have been widely used in the automotive industry, but are now available to meet the requirements of all types of industrial applications. 87

Square-Hole Inserts for Boring-Bars

A method of producing square holes in boring-bars designed to save time and expense has been developed by Sturdy Broaching Service, 13414 Fenkell Ave., Detroit 27, Mich. The new method eliminates hand-filing and the mediocre results usually obtained in that way. In using the new process, a "Sturdy" boring-bar insert is fastened in a drilled hole in the boring-bar. This insert, or adapter, consists of a round sleeve with a square hole broached through the center, which has a tapped thread at one end for a back-up screw.

To install the adapter in a boring-bar, it is only necessary to drill and ream a hole of the proper size and at the desired angle in the bar. The adapter is then inserted in the reamed hole, where it can be sweated, soldered, or welded in place. After the adapter has been secured, a hole can be drilled through the sleeve and bar simultaneously and tapped to receive a set-screw for clamping the tool bit in place. The adapter can be replaced in case the edge of the square hole becomes broken down or worn. These adapters are available for use with 1/4-, 3/8-, 1/2-, 5/8-, and 3/4-inch bits. They can be had finished to standard size on the outside diameter or with a stock allowance of approximately 0.015 inch to permit grinding to size. 88



"Midget" Automatic Spot-welder

Bench Type Spot-Welders

The Interstate Machinery Co., Inc., 1451 W. Pershing Road, Chicago 9, Ill., is placing on the market two new bench type universal "Midget" automatic spot-welders, designed for the precision welding of light metals. One welder, designated the U.S.P.1, has a rating of 1 kilovolt ampere, while the other —the U.S.P.3—has a rating of 3 kilovolt amperes.

These welders can be had with a built-in automatic weld timer; a separate timer panel for stitch welding; an automatic repeat pulsation timer; or a synchronous one-cycle timer. The welders are equipped with a water-cooled transformer, electrodes, and tips, and are air-operated. Control is by foot switch, solenoid valve, and pressure switch. 89

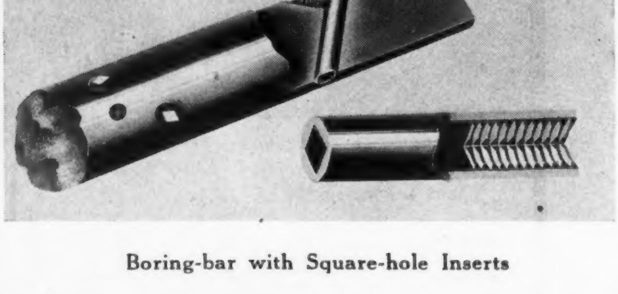
Lathe Centers with Cobalt-Tungsten Alloy Tips

The CMD helical-groove lathe centers made by the Chicago Mfg. & Distributing Co., Department M, 1928 W. 46th St., Chicago, Ill., are now available with cobalt-tungsten alloy tips, which assure efficient operation on the most difficult cutting jobs even when operating at red hardness. The abrasion-resistant cobalt-tungsten alloy is torch-welded—not brazed—to the center tip at a point midway to the conical section of the point, as shown in the illustration. Torch-welding fuses the cobalt-tungsten alloy with the steel base of the center, and assures rigidity and long, economical service. 90

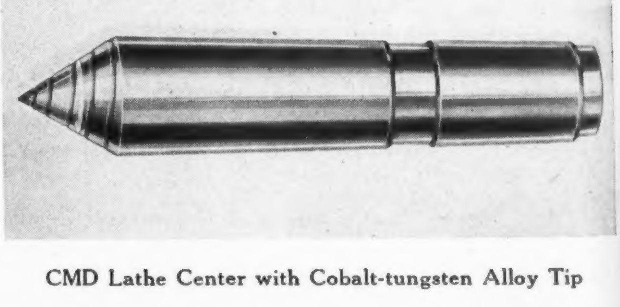
DoAll Grinder Equipped with New Five-In-One Hydraulic Control Valve

A new "five-in-one" hydraulic control valve has been incorporated in the DoAll G-10 surface grinder, manufactured by Continental Machines, Inc., 1312 Washington Ave. S., Minneapolis 4, Minn., to increase speed, efficiency, and simplicity of operation and to obtain greater accuracy. With this new control, it is claimed that surfaces can be precision-ground within accuracy limits of 6 micro-inches.

The G-10 machine, on which this hydraulic control is emloyed, has a variable table travel speed of 0 to 50 feet per minute, with a cushion reversing action operated by the pilot valve to give smooth, long-life performance. The cross-feed action—indexing at the end of the table travel—is actuated by a hydraulic cylinder, and can be controlled by step movements that are adjustable from 0.004 to 0.200 inch, depending on the kind of work being done. The cross-feed or traverse action, in addition to having hydraulic operation, is also actuated by an accurate screw located in the center of the cross-travel ways, and can be held to split "tenths of a thousandth" for

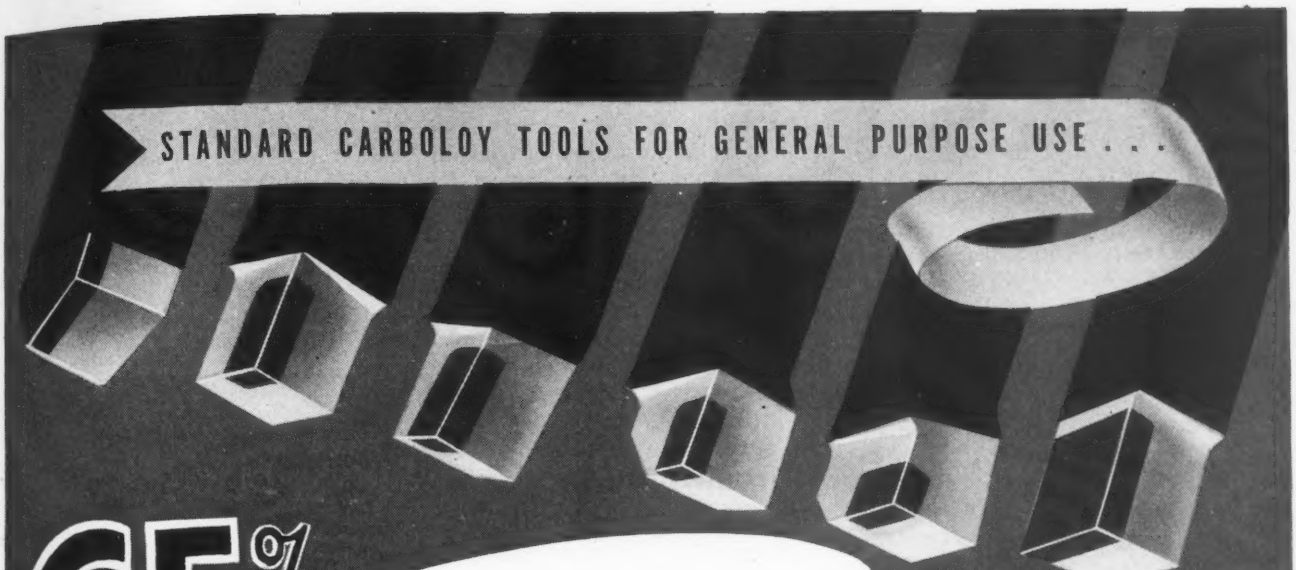


Boring-bar with Square-hole Inserts



CMD Lathe Center with Cobalt-tungsten Alloy Tip

To obtain additional information on equipment described on this page, see lower part of page 218.



65% OF ALL CARBOLOY

(TRADE MARK) CEMENTED CARBIDES

PRODUCED TODAY FOR MACHINING PURPOSES IS USED FOR . . .

CUTTING STEEL

. . . AND A LARGE PERCENTAGE OF THE CARBOLOY TOOLS USED, ARE STANDARDS COSTING LESS THAN ORDINARY TOOLS!

Tops in economy—tops in performance—on steel cutting! That's why, today, 65% of all Carboloy Cemented Carbides, produced by Carboloy Company, are grades for cutting steel.

Designed to cover the entire range of steel cutting—from heavy interrupted cuts, such as on tough cast armor plate, to high speed precision finishing of aircraft forgings—Carboloy Tools for steel cutting, stay on the job for long, continuous periods of operation, hold close tolerances, and produce an unusually high quality of finish.

Best of all, when you specify Carboloy "STANDARD" Tools, these results are available to you at an initial tool cost often *less than* that of *ordinary* tools. *Many Carboloy "Standards" are actually priced lower than "ordinary" tools.* Write for catalog GT-175R.

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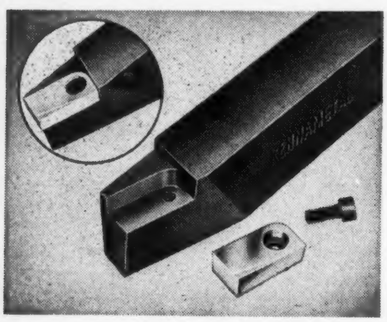
close tolerances on form grinding and tool grinding by manual operation.

When the automatic cross-feed is being used for sharpening dies or grinding any flat work to size, the cross-feed screw, or manual drive, is disengaged by a hydraulic cylinder, thus the accuracy of the cross-feed screw for form grinding is maintained over a long period of time. 91

"Screwed On" Kennametal Tool Blanks

Kennametal Inc., Latrobe, Pa., has recently developed a new type of Kennametal tool blank having a drilled and counterbored hole to



Kennametal Screw-fastened Tool Blank

provide for attaching it to a steel shank by means of a recessed-head cap-screw. The angularly set screw serves merely to hold the tip against the recess walls, which resist the main cutting thrust.

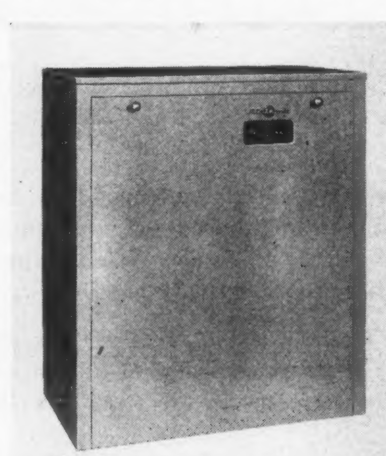
These blanks are now available in several of the larger sizes with formed clearance angles. They are made for both right- and left-hand cutting in all standard grades of Kennametal. Complete tools of various styles—straight edge, lead angle, offset, etc.—can now be furnished with the screwed-on tips, or separate standard blanks can be supplied to those who wish to make their own tools. Blanks of non-standard shapes and sizes having this feature can also be obtained for special tools, such as those employed in shell turning or form cutting of radii and grooves.

Advantages claimed for these tools and blanks include greater durability in use, more constant performance, and positive mechanical fastening; opportunity for heat-treating shanks to withstand the pressure of heavy cutting; simplified fastening—a cap-screw being the only removable element; removability of tip to permit independent grinding of shank; streamline design, with no projection beyond shank cross-section; reduced stock requirements, as tips of different Kennametal grades can be interchanged in the same shank; and simplified tool making, since most shops are better equipped to drill and tap holes than to braze joints properly. 92

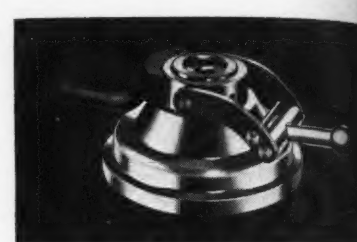
Chrysler Airtemp Unit for Controlling Temperature of Cutting Oils

The Airtemp Division, Chrysler Corporation, Dayton, Ohio, has announced the development of a "packaged" cooling unit designed to automatically maintain machine tool cutting oils and coolants at a uniform temperature. This oil-cooling, temperature-controlling unit is self-contained, and can be easily and quickly installed. It is adapted for use with hand-operated lathes; automatic lathes; automatic screw machines; milling and drilling machines; and honing, gear-shaping, broaching, and profiling machines.

It is claimed that this unit, by keeping the coolant at a uniform predetermined temperature, makes possible an increase in production, more accurate and more uniform work, and longer tool life. By keeping the work and machine cooled, less time is required for handling the pieces machined, changing tools or cutters, gaging work, and adjusting the machine. Holding the work at a uniform temperature also serves to prevent expansion and contraction between operations such as drilling, and eliminates inaccuracies caused by the accumulative effect of uneven expansion and contraction during a series of machining operations. 93



Airtemp "Packaged" Unit for Cooling Machine Tool Cutting Oils and Lubricants and Keeping Them at a Uniform Temperature



Low-height Type Collet Indexing Fixture Made by Zagar Tool, Inc.

Zagar Low-Height Collet Indexing Fixture

A new low type of indexing collet designed to give more space between the collet and the milling cutter has been brought out by Zagar Tool, Inc., 23886 Lakeland Blvd., Cleveland 17, Ohio. This fixture has been developed to save time and eliminate the complicated set-ups usually required in indexing work through a complete circle or 360 degrees. It has all the advantages of the regular Zagar holding fixture, in addition to the indexing feature, which provides means for obtaining any number of spacings from two to twenty-five. A four-, six-, and eight-division index-plate is included as standard equipment. Plates for all other spacings, including the regular, staggered, or special types, are furnished as extra equipment.

The body and base of the fixture consist of a tough, heat-treated alloy casting, ground all over to exact dimensions. The collet bushing, of alloy tool steel, is hardened and tempered to obtain tough, long wearing surfaces, and is ground to very close dimensions. Since the collet has no vertical movement, it is particularly well adapted for milling slots, straddle-milling, and similar applications where accurate duplication of parts is required.

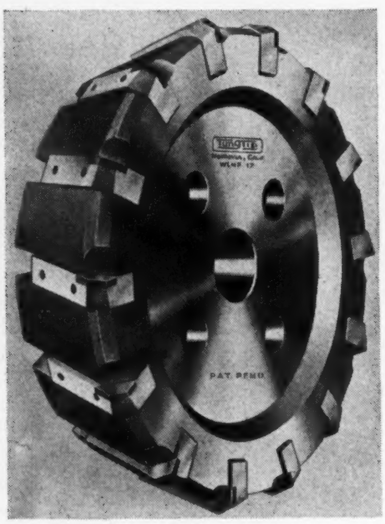
The tapped hole in the side of the fixture provides a convenient means of delivering cutting oil to the work under pressure. It is

To obtain additional information on equipment described on this page, see lower part of page 218.

recommended that a Zagar pump and tank be used to supply the cutting oil or that a suitable gear pump be provided. The cutting oil serves to wash out any chips that may become lodged in the fixture. In some cases, where no lubricant is required for milling operations, air can be substituted for oil to blow out the chips. 94

Tungtip Inserted-Tooth Milling Cutters

The Tungtip Tools Division of Lowell & Grayson, Monrovia, Calif., has brought out a line of milling cutters designed to take advantage of the characteristics of tungsten carbide. One new cutter in this line—a Tungtip inserted-tooth milling cutter—consists of carbide-tipped inserted teeth rigidly locked into the tool body without extraneous parts. These carbide-tipped tool-steel inserts are provided with a precision flat back and serrated front face, which assures uniform clamping pressure over the entire length of the insert. This rigid locking method maintains the blade in the correct position regardless of the cutting pressure.



Tungtip Inserted-tooth Milling Cutter

A simple ingenious mechanism provides for adjustment of the inserts to within 0.003 inch, thus eliminating the necessity for rough-grinding them. Replacement inserts are provided with the carbide face finish-ground and the cutting edges rough-ground.

Tungtip inserted-tooth cutters are available in face-milling and half-side milling styles. The alloy-steel body of the face mill has a ground surface for accurate location on the outside of the spindle nose of the milling machine. Half-side mills are provided with a precision-ground arbor hole and hub faces for accurate alignment when used for straddle milling operations. Both types of cutters are available with carbide teeth ground with corner angle or lead angle, or they may be had with inserts ground to a 90-degree corner for use where it is required to mill to a shoulder. 95

* * *

Army-Navy "E" Awards

The following firms have received the Army-Navy "E" Award for the fourth and fifth time:

American Machine and Metals, Inc., East Moline, Ill., has been presented with a new four-star Army-Navy "E" flag in recognition of more than three years of sustained high production of war implements. Its first flag was won in the autumn of 1942 for record output of 20-millimeter naval anti-aircraft gun mounts. The Delta Mfg. Co., Milwaukee, Wis., has also received the fourth star for its Army-Navy "E" flag in acknowledgement of its continued high rate of production of machine tools for the manufacture of military and naval goods.

Other concerns that have been honored five times by the presentation of the Army-Navy "E" Award for continued excellence in production are the Lipe-Rollway Corporation of Syracuse, N. Y., whose first award was received in October, 1942; Pratt & Whitney, Division Niles-Bement-Pond Co., West Hartford, Conn.; whose first award, received in August, 1942, was one of the earliest to be conferred; and Western Gear Works, Seattle, Wash.

The Black & Decker Mfg. Co., of Towson, Md., and the L. S. Starrett Co., Athol, Mass., have recently received the third renewal of the Army-Navy "E" Award for continued outstanding production. The awarding of the third and fourth stars permits the company receiving the stars to retain the flag for a full year instead of the usual six months period.

Keeping Employes Posted on Company Policies

It is becoming more and more apparent that many of the difficulties that have arisen in the past in manufacturing establishments have been due to the employes not having been properly informed on company methods and policies. Much friction between management and employes could be avoided by giving the latter an opportunity to appreciate the problems of the management and the reasons for certain policies and rules.

In order to explain in a direct and simple manner to the company's employes exactly what the company stands for, what its policies are, and why certain operating rules and regulations are necessary, the Federal Products Corporation, Providence, R. I., has published an attractive booklet entitled "Measuring Up," which briefly outlines how management and workers depend on each other in filling their jobs, and indicates why cooperation between management and men, as well as between the individuals in the company, is necessary. The financial aspect and the subjects of research and of manufacturing and selling precision measuring instruments are briefly outlined, and a complete outline is given of the company's policies, including employment, promotion, transfers, health, safety, insurance and pension plans, job evaluation, wages and hours. One of the excellent features of this presentation is that simple direct language is employed, so that no employe should find any difficulty in understanding the information.

* * *

Resistance Welder Manufacturers Announce Contest

In order to encourage the preparation of outstanding papers dealing with resistance welding subjects, the Resistance Welder Manufacturers Association, 850 Euclid Ave., Cleveland 14, Ohio, has announced a prize contest similar to that conducted annually in the past. The scope of this contest has been increased, bringing the total amount of the awards up to $1000. Complete information relating to the contest can be obtained by addressing the Association.

To obtain additional information on equipment described on this page, see lower part of page 218.

Make 10 types of prints instead of 1

SOUNDS INCREDIBLE if you've been seeing only one type of print year after year.

But when you are one of the thousands using Ozalid, you know this is possible . . . and how much it means to have a choice.

You always order the Ozalid print fitted for the job . . . and get it without delay.

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Since no baths or driers are employed—there is no distortion, there are few "limitations." So far, OZALID RESEARCH has created ten different and practical types of sensitized materials utilizing the unique dry-developing principle.

There will be more!

OZALID RESEARCH continues . . . and the machine you invest in today will provide even greater versatility tomorrow.

Write for free booklet of Ozalid prints and catalogue telling whole story.

ARMY E NAVY

OZALID

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For exceptionally durable prints for shop use, permanent file copies, etc.

5. Transblack Intermediate

6. Sepia-line Intermediate

7. Transparent Cloth

For producing "duplicate originals" which may be substituted for originals in subsequent print production; lines may be removed with OZALID corrector fluid—invaluable time saved when making design changes.

8. Transparent Foil

For making composite prints; reclaiming old, or worn originals; for producing extra-fast duplicate originals.

9. Chartfilm

For producing lustrous black-line prints on durable white plastic base. Oil proof, waterproof. Ideal for use as instrument panels, identification cards, etc. No protective covering needed; clean with damp rag.

10. Dryphoto

For almost instantaneous, high-quality reproductions of any photographic subject: in black, sepia, or two-tone effect.

Special "Hy-Mac" Machine for Pressing and Staking Wedge Pins in Track Shoes

A special-purpose machine for pressing and staking wedge pins in place on T-66 track shoes was recently completed by the Design and Build Division of Hydraulic Machinery, Inc., 12825 Ford Road, Dearborn, Mich. The machine is hydraulically operated throughout, the operating cycle being arranged for automatic or semi-automatic control. After the shoes are assembled in sections of ten, they enter the part of the machine where the pins are manually inserted, the sections taking their normal contour on the machine bed.

The machine performs the operating cycle as follows: (1) Hydraulically actuated anvils rise to support the four points on each shoe where pins are inserted; (2) vertical rams advance, pressing the four pins into place simultaneously; (3) upon completion of the pressing operation, the rams withdraw and the turret nose-piece is rotated to the staking position, after which the rams advance again and perform the staking operation; (4) rams and anvils withdraw; (5) hydraulic indexing mechanism moves complete section forward to the next shoe, and the cycle is repeated.

The total time required to complete a cycle is twenty-one seconds. Each of the four cylinders that actuate the rams has a capacity of 35 tons, or a combined rating of 140 tons. The "Hy-Mac" power unit is installed adjacent to the press, and contains pumps, motor, oil pressure reservoirs, and relief valves.

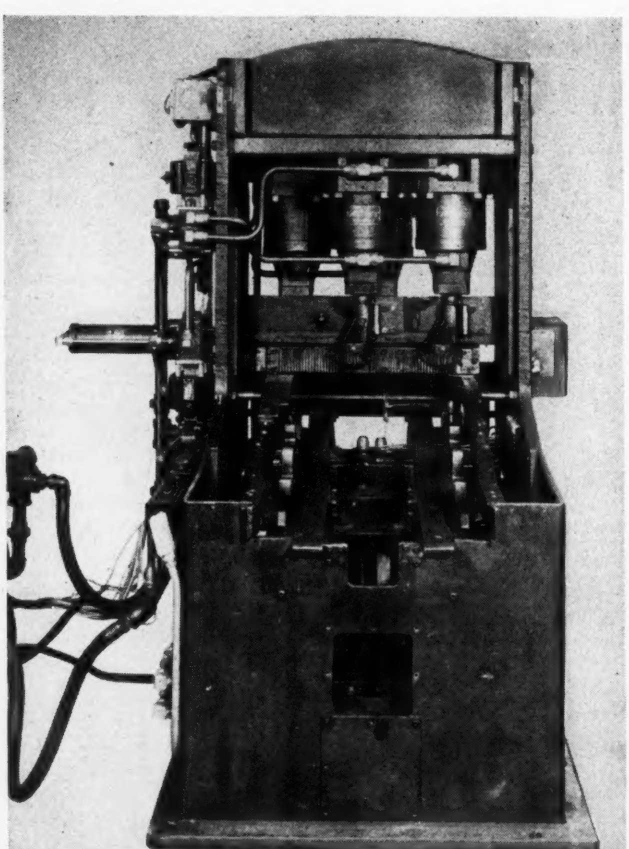
* * *

Special hot-box "detectives," which sound an automatic warning bell in the locomotive cab should a journal on one of the trucks become heated in excess of 220 degrees F., are part of the accident-prevention equipment on the Diesel locomotives built by the Electro-Motive Division of General Motors.

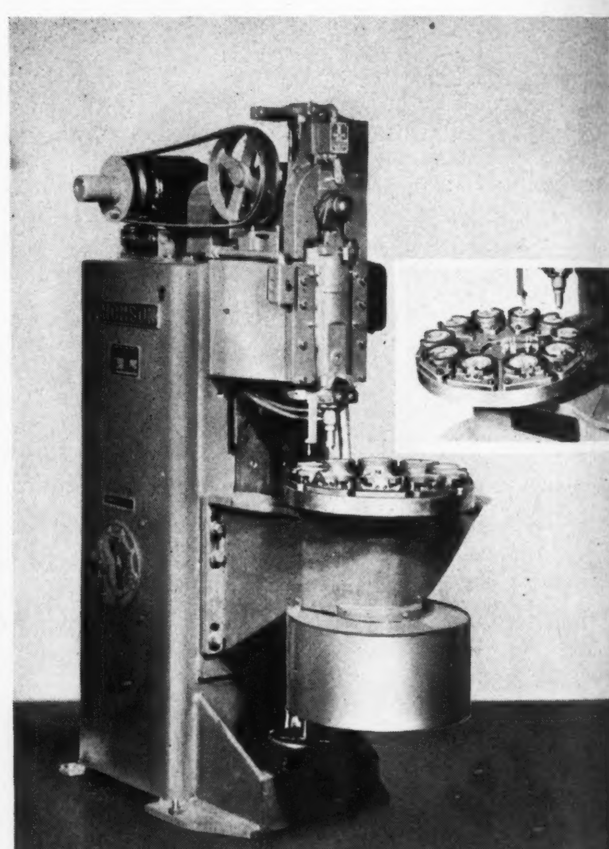
Welding Opening Keys to Tin Cans

The accompanying illustration shows a welding press made by the Thomson-Gibb Electric Welding Co., Lynn, Mass., which has been equipped with a ten-station dial feed for welding opening keys to tin cans at the rate of fifteen to forty-five per minute. The keys are dropped into the dial pockets and fed around for the welding operation. This dial feed has been especially designed to insure fast, simple, and positive operation.

The Thomson No. 1 welding press, to which the dial feed is attached, can be furnished with transformer capacities of 30, 40, 50, or 75 kilovolt-amperes, and throat depths of 12, 18, 24, or 30 inches, which makes it adaptable for a wide range of work. The sliding head is actuated by a special cam designed to slow down the electrode as it approaches the work and thus avoid "hammering." Pressure can be applied by an adjustable spring or air lock, or straight air pressure can be employed.



"Hy-Mac" Machine Designed for Pressing in and Staking Track-shoe Wedge Pins



Thomson-Gibb Electric Welding Machine Equipped for Welding Opening Keys to Tin Cans

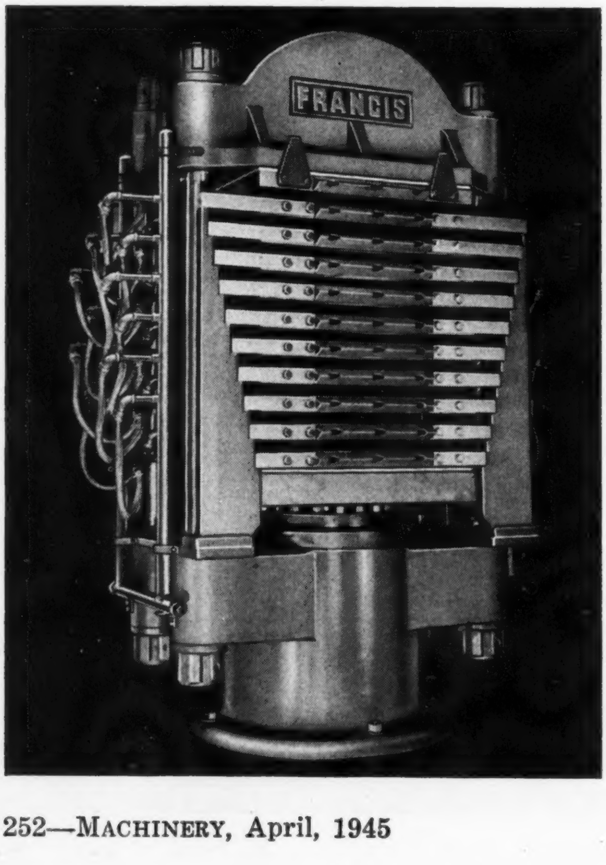
The lower arm can be mounted on a column or apron, or a lower knee and flat upper terminal pad can be used. Interchangeability of all these parts make it possible to adapt this welding press to a wide variety of spot and projection welding operations.

* * *

Steam-Plate Hydraulic Press for Laminated Plastic Work

A hydraulic press equipped with eleven steam plates, which was designed for making laminated plastic parts required in the war effort, but is well adapted for general-purpose steam-plate production work, has been brought out by the Charles E. Francis Co., Huntington, Ind. This press has automatic pressure and temperature controls, and can be furnished either with or without a motor-driven pump unit. The particular press shown in the accompanying illustration is a 30- by 30- by 2-inch size, and has a capacity of 153 tons.

Among the outstanding features of the press may be mentioned the extremely rigid plate support, vee designed for easy loading, and strain-rod nuts equipped with a special locking device that prevents them from becoming loose.



Hydraulic Press with Eleven Steam-heated Plates Designed for the Fabrication of Laminated Plastic Products

Metal-Cutting Film

A twenty-minute sound film, narrated by Lowell Thomas, has been made available to industry by A. P. de Sanno & Son, Inc. This company, which manufactures abrasive cutting-off machines and abrasive cutting-off disks, has presented to industry, in this 16-millimeter sound film, a graphic description of the abrasive cutting-off method. The picture gives a complete conception of the cutting off of many types of stock, including the cutting of 1-inch square unannealed stainless steel in 2 1/2 seconds. It is equivalent to a thorough demonstration of the abrasive cutting-off method.

The film is available to engineering societies, training schools, educational institutions, and manufacturers who engage in cutting-off operations by application to A. P. de Sanno & Son, Inc., 106 S. 16th St., Philadelphia 2, Pa.

* * *

An interesting example of the use of magnesium for moving mechanisms is the knife frames on bread-slicing equipment. The weight of a certain unit was reduced from 44 to 13 pounds by using magnesium, which also reduced bearing loads and vibration.

Quality Control Course

The State University of Iowa, College of Engineering, is offering an eight-day tuition-free course in quality control by statistical methods. The course will be given from May 16 to 24, inclusive, in cooperation with the War Production Board and the United States Office of Education under the Engineering, Science, and Management War Training Program.

This is the second time this course has been given, the first course, held last year, having been so successful that it was decided to offer the course again this year. Nearly 150 representatives of industry from eight states, as well as officers and employes of the armed forces, attended the special one-day session for executives held in connection with the first course last October. Of this number, over seventy registered for the full eight-day course.

A feature of these courses is a follow-up program extending over a period of approximately thirty weeks in which the industrial representatives meet with a representative of the university to discuss common problems and to obtain additional information.

In general, persons eligible for the course are executives or employes of plants engaged in any type of production related to the war effort, as well as officers and employes of the armed forces. The course is intended for persons in a supervisory position, who can apply the knowledge gained immediately. Those interested can obtain additional information from Professor Earle L. Waterman, College of Engineering, State University of Iowa, Iowa City, Iowa, or from Professor Lloyd A. Knowler, Department of Mathematics, State University of Iowa.

* * *

Carbon brushes for airplane generators used at very high altitudes in the past wore out in as little as an hour. Sometimes they failed in a few minutes if the generator was called on to deliver large amounts of power. In cooperation with the Stackpole Carbon Co., the Westinghouse Electric & Mfg. Co., Pittsburgh, Pa., has developed brushes that deliver electric power for two hundred hours or more, in planes 30,000 feet in the air.

News of the Industry

Alabama, Florida, and Texas

BRIGGS CLARIFIER CO., Washington, D. C., has appointed LA GRAVE & CO., 812 First National Bank Annex, Mobile 6, Ala., distributor of Briggs products in central and southern Mississippi, southern Alabama, and northwestern Florida.

JOHN D. HOMAN, 714 S. Orleans Ave., Tampa 6, Fla., has been appointed regional sales representative of the STEARNS MAGNETIC MFG. CO., Milwaukee 4, Wis.

STERLING ALLOYS, INC., Woburn, Mass., have appointed the GLIDDEN ENGINEERING & EQUIPMENT CO., First National Bank Bldg., Houston, Tex., engineering service representative of the company for the states of Texas, Oklahoma, New Mexico, Louisiana, Mississippi, and western Tennessee.

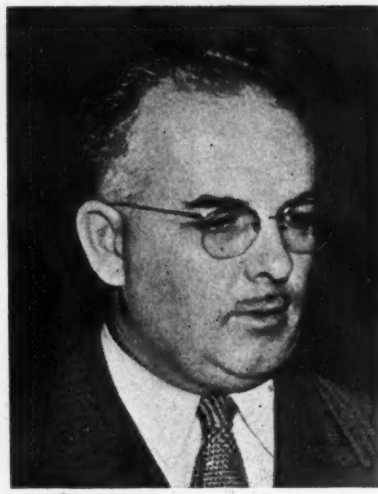
California and Washington

COLONEL O. K. GRAEF, who was retired from the Army in November, 1944, has resumed his former association with the Bearings Division of Joseph T. Ryerson & Son, Inc., Chicago 80, Ill. Colonel Graef will make his headquarters at the Los Angeles district sales office, 816 W. 5th St., Los Angeles, Calif., where he will have charge of the West Coast sales of Ryertex non-metallic bearings and Glyco babbitt metals. GEORGE W. GILLILAND, who was appointed manager of the Los Angeles office in June, 1944, remains in charge of sales of steel and metal-working machinery in the Los Angeles area.

THOMAS J. BANNAN has been elected president of the Western Gear Works, Seattle, Wash., and of its associate plant, the Pacific Gear & Tool Works, San Francisco, Calif. Mr. Bannan, who has been executive vice-president of these companies for a number of years, succeeds his father, P. L. BANNAN, SR., who died last October. The other officers elected are BERCHMAN A. BANNAN, vice-president; PHILIP L. BANNAN, JR., treasurer; and CHARLES F. BANNAN, secretary.

Illinois and Missouri

FOOTE BROS. GEAR & MACHINE CORPORATION, Chicago, Ill., announces the election of the following officers at a recent meeting of the board of directors: L. F. CAMPBELL, vice-president in charge of manufacturing, Precision Gear Division; R. B. MOIR, assistant



L. F. Campbell, Vice-president in Charge of Manufacturing of Foote Bros. Precision Gear Div.

vice-president in charge of sales engineering, Industrial Gear Division; and E. A. JOHNSON, assistant vice-president in charge of manufacturing, Industrial Gear Division.

AMERICAN MACHINE AND METALS, INC., East Moline, Ill., announces the establishment of three new district office headquarters at Dallas, Tex., Minneapolis, Minn., and Philadelphia, Pa. OLIVER H. CASTLE is manager of the Dallas office, G. W. JOHNSON, manager of the Minneapolis office, and HAROLD N. EWERTZ, manager of the Philadelphia office.

HENRY P. WOOD has joined the staff of Clayborne Distributors, Ltd., 209 S. La Salle St., Chicago, Ill., an organization of manufacturers' representatives. Mr. Wood has a total of twenty-eight years of engineering experience, and will assist manufacturers of plant equipment with their sales, service, and installation problems.

EDWARD H. GRUMICH has been appointed vice-president in charge of manufacturing and plant operations for the Siewek Tool Division of Domestic Industries, Inc., Chicago, Ill. He was previously production manager in charge of the Carburetor Division of Bendix Aviation.

E. W. ROMIG has been appointed vice-president in charge of the Cleveland district for the Claude S. Gordon Co., Chicago, Ill., metallurgical and heat-treating equipment engineers. Mr. Romig was previously chief engineer of the Cleveland plant.

G. H. SMITH has been appointed vice-president and general manager of the Deepfreeze Division of the Motor Products Corporation, North Chicago, Ill. Mr. Smith was previously associated with the Magnavox Co., Fort Wayne, Ind., as a merchandising counselor.

ROBERT SIMKINS has been named vice-president of the Trundle Engineering Co., Cleveland, Ohio, management engineers, succeeding W. S. FORD. He will have charge of western sales, with headquarters in Chicago, Ill.

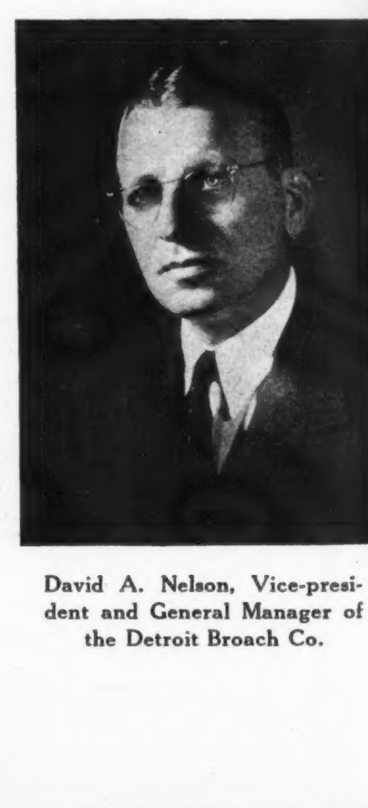
CARL F. JENSEN, JR., has been appointed district engineer of the northwestern district of the Lamp Division, Westinghouse Electric & Mfg. Co. His headquarters will be at 20 N. Wacker Drive, Chicago, Ill.

R. O. HERBIG, since 1921 district sales manager in Chicago for the Reliance Electric & Engineering Co., Cleveland, Ohio, has been appointed central western sales manager of the company.

W. E. FRY, B.M.A. Bldg., Kansas City, Mo., has been appointed manufacturer's representative for the ECLIPSE COUNTERBORE CO., Detroit, Mich., in the west Missouri and Kansas territories.

Michigan and Wisconsin

DAVID A. NELSON, who has been manager of the West Coast plant of the Detroit Broach Co., Detroit, Mich., for



David A. Nelson, Vice-president and General Manager of the Detroit Broach Co.

the last year and a half, has returned to Detroit in the capacity of vice-president and general manager of the company.

BAKER, PLANCON & GILMORE CO., 7310 Woodward Ave., Detroit, Mich., is a newly organized firm of manufacturers' representatives. The new organization will represent the APEX MACHINE & TOOL CO. and the BUCKEYE TOOLS CORPORATION, of Dayton, Ohio; STUDEBAKER MACHINE CO., Maywood, Ill.; and KETT TOOL CO., Cincinnati, Ohio.

T. B. MARTIN has been made director of advertising for both the Detroit and Milwaukee electrical divisions of the Square D Co., Detroit, Mich. He will continue to make his headquarters at the Milwaukee plant, where he has been serving as sales manager of the Industrial Controller Division since 1929. FRANK ROBY, who left the Industrial Controller Division of the company in 1942 to enter the armed services, has rejoined the company as sales manager of that division, with headquarters in Milwaukee.

New England

FRANKLIN R. HOADLEY has been elected president of the Farrel-Birmingham Co., Inc., Ansonia, Conn. Mr. Hoadley has been associated with the company since his graduation from Yale University in 1914, with the exception of a period during World War I, when he served as a lieutenant in the Ordnance Department. In 1918, he returned to the Farrel-Birmingham Co., and became foundry manager in 1919. He was elected vice-president and a member of the executive committee in 1930. For the last eight years, Mr. Hoadley has been president and treasurer of the ATWOOD MACHINE Co., Stonington, Conn., which company has been purchased by the Farrel-Birmingham Co. He will continue the general supervision of this plant, as well as assuming management of the company's other three plants in Ansonia and Derby, Conn., and Buffalo, N. Y.

Franklin R. Hoadley, Newly Elected President of Farrel-Birmingham Co., Inc.

DON E. MILLER has been appointed executive assistant to John J. Prindiville, Jr., vice-president and works manager of the Lapointe Machine Tool Co., Hudson, Mass., manufacturer of broaches and broaching machines. Mr. Miller was formerly factory manager of the Garfield Division of the Houdaille-Hershey Corporation, Buffalo, N. Y.

Don E. Miller, Executive Assistant to Vice-president and Works Manager, Lapointe Machine Tool Co.

DR. ZAY JEFFRIES, of the General Electric Co., Pittsfield, Mass., has been awarded the newly established Powder Metallurgy Medal of the Stevens Institute of Technology, Hoboken, N. J. The medal, which was presented for the first time on behalf of the trustees of the Institute, is made entirely from powdered metals, and is awarded for "outstanding work in the field of powder metallurgy." It is expected that this medal will be awarded annually.

CHARLES R. CROWDER, manager of the Automotive and Aircraft Service Equipment Division of the Van Norman Co., Springfield, Mass., has been elected president of the Sales Managers Club of Springfield. Mr. Crowder has been associated with the Van Norman Co. since 1929, and has been manager of the Automotive Division since 1937.

STANLEY & PATTERSON DIVISION OF THE FARADAY ELECTRIC CORPORATION has moved to 434 Newbury St., Boston 15, Mass. PAUL E. FREIWALD has been made sales manager of this division, and GEORGE RICK has been placed in charge of manufacturing.

DONALD H. DALBECK has entered the employ of the Reed-Prentice Corporation, Worcester 4, Mass., as controller. He was formerly connected with the Nice Ball Bearing Co., of Philadelphia.

New York

ALTON PARKER HALL has been appointed general manager of sales of the American Chain & Cable Co., Inc., 230 Park Ave., New York City. He had been assistant general manager of sales for a year, and prior to that was with the Bethlehem Steel Co. for twenty-two years. J. J. WALSH, who has been associated with the American Chain & Cable Co. for twenty-two years, has been appointed district sales manager for the New York district of the Page Steel and Wire Division of the company at 230 Park Ave.

GEORGE SCHERR CO., INC., manufacturer and distributor of precision measuring instruments, optical inspection tools, and gages, announces the establishment of a machine and precision exhibit at its new location, 200 Lafayette St., New York 12, N. Y., where the latest developments in precision measuring, inspection, and manufacturing are shown. In addition, this exhibit center offers manufacturers and developers of new machines, tools, and methods an opportunity to demonstrate their products.

FREDERICK P. HUSTON has been placed in charge of railroad developments in the application of nickel alloy steels, cast irons, Monel, and other nickel alloys for the Development and Research Division of the International Nickel Co., Inc., 67 Wall St., New York City. Mr. Huston has been associated with the Inco Mill Products Division since June, 1940.

HOWARD B. HALL, consulting management engineer, has been appointed representative of DESIGNERS FOR INDUSTRY, INC., Cleveland, Ohio, in the New York, northern New Jersey, and Connecticut territories. Mr. Hall's headquarters are in the National City Bank Bldg., 17 E. 42nd St., New York City.

GEORGE STEVEN has been appointed executive engineer of the Buffalo, N. Y., Works of Worthington Pump & Machinery Corporation. HAROLD W. WHITING, formerly Mr. Steven's assistant, will succeed him as chief engineer of the Buffalo Works Compressor Division.

DONALD J. REESE, who has been with the Steel Division of the War Produc-

tion Board at Washington, D. C., since April, 1942, has resumed his duties with the Development and Research Division of the International Nickel Co., Inc., 67 Wall St., New York City.

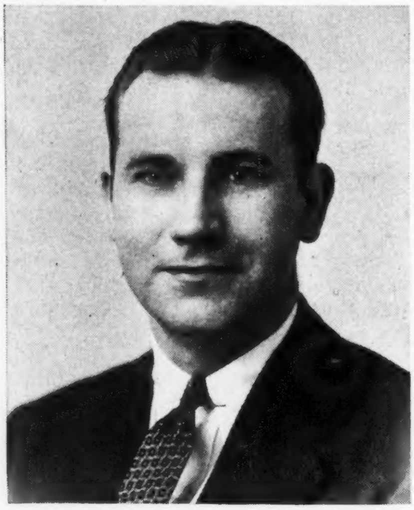
Ohio

W. E. GRAVES has been appointed sales manager of the Steel Improvement & Forge Co., Cleveland, Ohio, manufacturer of forgings and boiler and tank accessories. R. A. B. WILLIAMS, 216 Professional Bldg., Los Angeles, Calif., has been appointed sales representative of the company for the Pacific Coast states—California, Oregon, Washington, and Arizona.

GEORGE C. MCMULLEN has been appointed assistant to the president, and vice-president in charge of product research and development, of the Tyson Bearing Corporation, Massillon, Ohio. HARRY L. VINES has been named director of sales for the corporation. Mr. Vines was formerly western manager for R. G. LeTourneau, Inc., of Stockton, Calif.

LOUIS POLK, president of the Sheffield Corporation, Dayton, Ohio, has been awarded the Gold Medal of the Army Ordnance Association with the inscription: "To Louis Polk for outstanding service to Army Ordnance." Mr. Polk has been instrumental in the development of measuring instruments and gaging system standardization.

JOHN E. PONKOW, formerly chief electrical engineer and supervisor of experimental engineering for the Federal Machine & Welder Co., Warren, Ohio, manufacturer of resistance welding equipment, has been appointed sales manager of the company. Mr. Ponkow, who was graduated from Johns Hopkins University with a BE degree, was formerly with the Westinghouse organization, where he was engaged in power design on direct-current rotating equipment and later on general industrial design. He joined the Federal Machine & Welder Co. in 1941 as assistant chief electrical engineer, and became chief electrical engineer in 1943. He is a member of the American Institute of Electrical Engineers and the American Welding Society.



John E. Ponkow, Recently Appointed Sales Manager of Federal Machine & Welder Co.

MAURICE SCHAPIRO, advertising manager of the Cincinnati Planer Co., Cincinnati, Ohio, for the last three years, has been made assistant sales manager of the P. H. Davis Co., Cincinnati. Mr. Schapiro will continue to edit the Planer Planet, house organ of the Cincinnati Planer Co.

W. R. PERSONS has been appointed assistant sales manager of the Lincoln Electric Co., Cleveland, Ohio, manufacturer of arc welding equipment. He is also chairman of the firm's junior board of directors. Mr. Persons has been with the company for the last ten years.

MYRON H. BUEHRER, who for twelve of his seventeen years with the Boice-Crane Co., Toledo, Ohio, served as sales manager, has just been advanced to the position of general manager. He will continue to direct advertising and sales.

FORD MACHINERY CO., 1301 Toledo Trust Bldg., Toledo 4, Ohio, has been appointed agent for the complete line of lathes and cutter grinders made by the LEBLOND MACHINE TOOL CO., Cincinnati 8, Ohio.

Pennsylvania and District of Columbia

THOMAS MACHINE MFG. CO., Pittsburgh, Pa., announces the appointment of the following sales agents: GENERAL MACHINERY CORPORATION, Boston, Mass.; GIEBEL, INC., New York, N. Y., and New Haven, Conn.; C. H. BRIGGS MACHINE TOOL CO., Syracuse, N. Y.; W. W. WENTZ, Rochester, N. Y.; J. L. OSGOOD MACHINERY & TOOL CO., Buffalo, N. Y.; L. A. BENSON CO., Baltimore, Md.; SMITH COURTNEY CO., Richmond, Va.; CHANDLER MACHINERY CO., Atlanta, Ga.; GEORGE D. MILLER CO., Cleveland, Ohio; BROKAW MACHINERY CO., Cincinnati, Ohio; JOSEPH MONAHAN, Grand Rapids, Mich.; BRYANT MACHINERY & ENGINEERING CO., Chicago, Ill.; QUINN & QUINN, Birmingham, Ala.; Noland Co., Chattanooga, Tenn.; and FREDERIC & BAKER, Shreveport and New Orleans, La.

NICK KOPPI, formerly of the sales and service department of the LeBlond Machine Tool Co., Cincinnati 8, Ohio, has been appointed manager of the Calco Machinery Co., 1420 Chestnut St., Philadelphia 2, Pa., LeBlond agent in the District of Columbia, Delaware, Maryland, southern New Jersey, and eastern Pennsylvania. The Calco Machinery Co. will also represent the CARLTON MACHINE TOOL CO., manufacturer of radial drills, in the same territory.

EDWARD J. CHARLTON, who since 1942 has been assistant to the president of Lukenweld, Inc., Coatesville, Pa., has been appointed manager of development engineering for the Lukens Steel Co. and its subsidiaries, By-Products Steel Corporation and Lukenweld, Inc. Mr. Charlton has been connected with the company since 1931, when he joined the engineering staff as a designing engineer.

R. J. BENKART, 2017 Preble Ave., Pittsburgh 12, Pa., has been appointed representative for the AJAX ELECTRIC CO., INC., Philadelphia, Pa., manufacturer of Ajax-Hultgren electric salt bath furnaces. He will represent the firm in West Virginia, western Pennsylvania, and southeastern Ohio.

HOMESTEAD VALVE MFG. CO., INC., Coraopolis, Pa., announces that production has started in the company's new cleaning-compound manufacturing plant at Edgeworth, Pa., where "Hypressure Jennys" and other steam spray cleaning machines are being manufactured both for the armed forces and industry.

W. E. MULLESTEIN, who has been acting as assistant sales manager for Lukenweld, Inc., a division of Lukens Steel Co., Coatesville, Pa., has been granted a leave of absence to serve in an overseas capacity with the U. S. War Department.

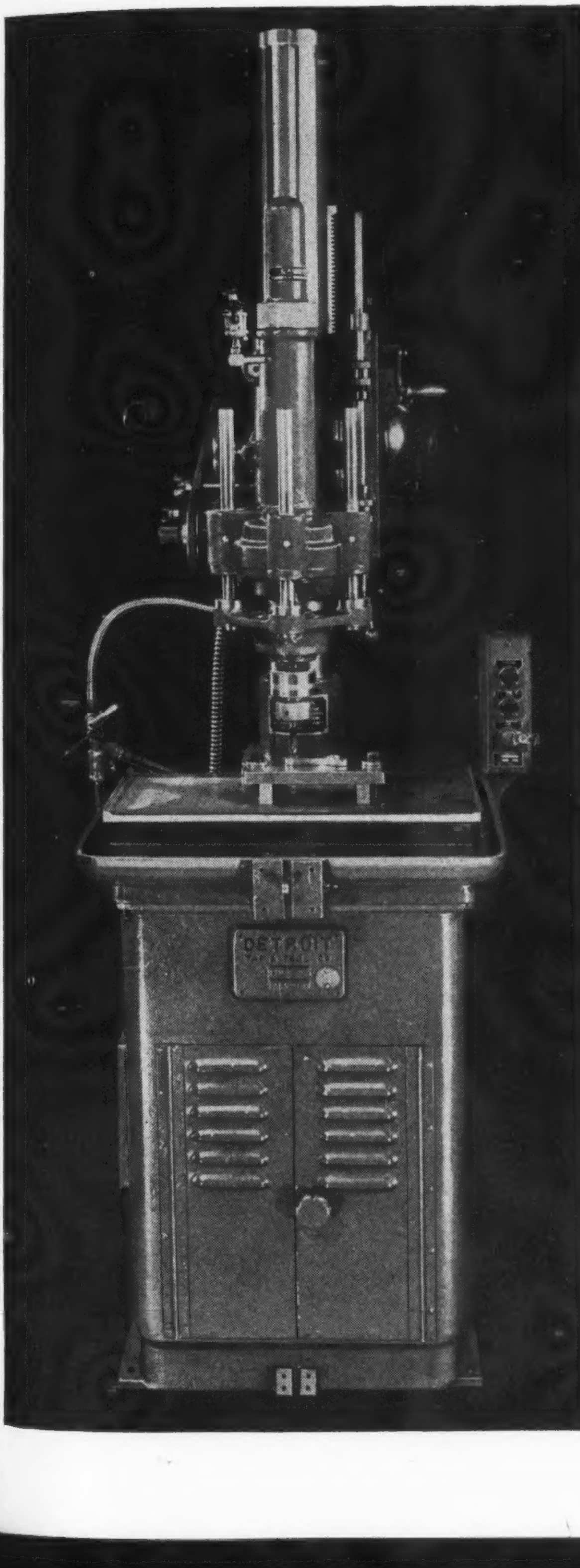
WALTER F. MYERS has been appointed to the staff of the Washington, D. C., office of the Cooper-Bessemer Corporation, Mount Vernon, Ohio, manufacturer of Diesel engines and compressors. Mr. Myers has served during the last twenty-five years as sales engineer, construction engineer, and consulting engineer for public and private corporations. He will assist CHARLES G. COOPER, director of the Washington office, in the handling and supervision of government contracts and sales and service in the southern Atlantic states.

* * *

Production Management

An informative booklet on production management and how it affects productivity, costs, and employment has been brought out by Albert Ramond & Associates, Inc., Chrysler Bldg., New York 17, N. Y. This booklet outlines in a simple manner some of the underlying facts pertaining to the methods used in production management and control.

180% Increase in production
25% Increase in tap life
Fewer rejects



With *unskilled women* operators replacing trained men, Flint Manufacturer's Machine Service Co. obtained the above results by using DETROIT lead-screw type tapping machines instead of conventional equipment.

The job involved was tapping a 7/16—20 NS thread 3/8 in. deep to a class 3 fit in a 50 cal. machine gun part made of tough 1050 steel.

Equipment consisted of a Detroit Light Duty LTM-16 machine equipped with simple locating pins on the work table and floating tap holder.

Production obtained per machine was 450 pieces per hour equivalent to an overall average, floor to floor, of 8 seconds per piece. High accuracy obtained is credited to an unique LEAD SCREW drive.

We will be glad to furnish you with a bulletin covering the Detroit LTM line of tapping machines. Ask for Bulletin LTM-44.

DETROIT
TAP & TOOL CO.
8432 BUTLER AVENUE . . . DETROIT 11, U. S. A.

Obituaries

Bertram B. Quillen

Bertram B. Quillen, president of the Cincinnati Planer Co. and the Acme Machine Tool Co., both of Cincinnati, Ohio, died suddenly on February 26 at his home in Cincinnati. Mr. Quillen was born in Lebanon, Ind., in 1869. After receiving his education in Indiana, he was first employed in business in Chicago, but shortly afterward went to Cincinnati where he became employed with the Lodge & Davis Machine Tool Co. Leaving that organization, he founded, in 1898, the Cincinnati Planer Co. with William H. Burtner and George Langen, the latter now vice-president of the company. After the death of Mr. Burtner, C. H. M. Atkins became associated with the company and is now chairman of the board.

The first plant of the company was located on Buck St.; by 1907, the business had increased to a point where larger quarters became necessary, and the company was one of the first machine tool organizations to build a plant in Oakley.

Mr. Quillen, in addition to his interest in the machine tool industry, was a director of the First National Bank of Norwood and a member of the advisory board of the Oakley branch of the Fifth-Third Union Trust Co. He was a member of the American Society of Tool Engineers.

Because of his friendliness and interest in the welfare of his employes, they generally referred to him as "Uncle Bert." The door of his office was always open to anyone working in the plant who wished to obtain his advice or help. He was widely known throughout the machinery industries, and his many friends will deeply regret to learn of his death.

Bertram B. Quillen

William Baker

Lieutenant Commander William Baker, vice-president and a director of Baker Brothers, Inc., Toledo, Ohio, manufacturer of machine tools, died on March 2, in Huntington, L. I., at the age of forty-nine years. Commander Baker was in charge of naval procurement in the Brooklyn Navy Yard, and was living temporarily in the East. He had served both in this war and in World War I, having left school in his senior year to enlist in the previous war. He served in a Mosquito fleet and was flying instructor in the Naval Air Force at Key West and Pensacola, Fla., having the commission of lieutenant, j.g. In 1941, he was recalled to active service in the Navy and was stationed in the Naval Procurement Division in Cleveland before being transferred to Brooklyn.

Mr. Baker attended the Hotchkiss School in Lakeville, Conn., and was graduated from the Sheffield Scientific School, Yale University, in 1918. He had been active in the civic affairs of Toledo, and was a past secretary of the National Metal Trades Association. Surviving him are his wife, two daughters, two sons, his mother, two sisters, and two brothers.

Raymond H. Filsinger, purchasing agent for the Crucible Steel Co. of America, 405 Lexington Ave., New York City, died of a heart ailment on March 5 while visiting his daughter in Scarsdale, N. Y. He was fifty-eight years old. Mr. Filsinger was employed by the Sanderson Works of the Crucible Steel Co. of America in 1906, and later entered the employ of the Halcomb Steel Co., which became the Halcomb Division of the Crucible Steel Co. He was purchasing agent of this division for many years. In 1920, Mr. Filsinger was transferred to Pittsburgh and later to New York, at which time he was appointed general purchasing agent of the company.

John W. Rathbun

John W. Rathbun, who retired as general manager of the S. W. Card Mfg. Co., Mansfield, Mass., in 1942, after having served nearly fifty years with the company, died on January 16 in the Sturdy Memorial Hospital, where he had been a patient much of the time since he suffered a shock last July.

Mr. Rathbun was born in 1871 in Coventry, R. I. He went with his family to Mansfield when he was six years old, and graduated from the Mansfield High School in 1889. For three years he taught school; then he decided upon a business career and entered Comer's Business College in Boston. It was through the officers of this college that, in 1893, he learned that a bookkeeper was wanted at what was then known as the S. W. Card Co., in Mansfield. From this position, he ultimately became the general manager of the firm.

In 1900, Mr. Rathbun became the company's first salesman, and set out on a thirteen-week business trip. He only got as far as Columbus, Ohio, however, when he was called back to help pack and ship the orders he had sent back to the factory. For the next twenty years, he traveled extensively for the company, acquiring many new dealers whose esteem he always retained. Throughout the industry, his opinions on standardization and on elimination of waste were highly regarded. He followed closely the developments of high-speed steel ground thread taps and the improvements in heat-treatment processes.

When the S. W. Card Mfg. Co. was sold in 1913 to the Union Twist Drill Co., of Athol, Mass., Mr. Rathbun became its sales manager; in 1921 he became general manager. He was also treasurer of the New England Drawn Steel Co. and a director of the Mansfield Cooperative Bank. When he retired from the Card organization May 29, 1942, he also relinquished his duties

John W. Rathbun

as treasurer of the New England Drawn Steel Co.

Mr. Rathbun is survived by his wife, a daughter, a grandson, and two brothers.

Albert E. Robinson

Albert E. Robinson, for sixty-one years associated with the American Tool Works Co., Cincinnati, Ohio, died on February 28, aged seventy-nine years. Mr. Robinson was born in Covington, Ky., in 1866. He first became associated with the American Tool Works Co. in 1883, and retained his connection with the company from that time on, except for two short intervals. In 1886, he worked for the Weir Frog & Switch Co. of Cincinnati, and in 1890-1891 he was superintend-

Albert E. Robinson

ent of the Indiana Switch & Frog Co., Indianapolis.

His record with the American Tool Works Co. was one of steady advancement from the position of tool boy to that of works manager. In 1943, he was made vice-president and elected a member of the board of directors. Of late years he requested to be given less arduous duties, and was made assistant to the president and consultant on mechanical matters and new machine design. It was during this period that the new Hole Wizard radial drills and Pacemaker lathes were developed, which remain a monument to his genius.

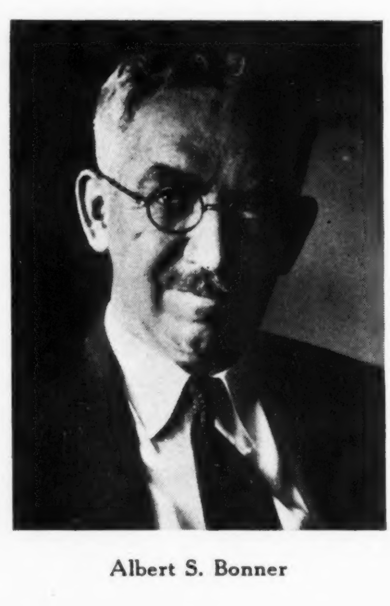
Mr. Robinson was a man of the highest character. He had a remarkable talent for inspiring those under him to put forth the best that they had. He was always keenly interested in training the young, and many successful businessmen owe their progress to his influence. He is survived by his widow and three sons.

Ernest J. Poole, Jr.

Ernest J. Poole, Jr., vice-president in charge of manufacture and a director of the Carpenter Steel Co., Reading, Pa., died on February 19 in Reading at the age of forty-eight years. Mr. Poole was a graduate of the United States Naval Academy at Annapolis. He entered the employ of the Carpenter Steel Co. in 1922, and succeeded his father as vice-president of the company upon the latter's death in 1937.

Albert S. Bonner

Albert Sydney Bonner, president of the Clark Equipment Co., Buchanan, Mich., manufacturer of automotive equipment, died at his home in Buchanan, on February 8 at the age of fifty-three years. Mr. Bonner was born on August 20, 1891, at Staten Island, N. Y. He graduated from Princeton University in the class of 1913. Entering the employ of the Clark Equipment Co. in April, 1915, in the stock



Albert S. Bonner

department of the Axle Division, he rose steadily until, in 1924, he became secretary-treasurer, and in 1925, a director of the company. In April, 1938, he was made executive vice-president, and in August, 1942, was elected president. Mr. Bonner is survived by his wife, a daughter, and a son.

Byron H. Newell

Byron H. Newell, assistant manufacturing manager of the Buick Motor Co., Flint, Mich., died suddenly on March 12 at his home in Flint, aged fifty-four years. Mr. Newell had been connected with the Buick organization for eleven years.

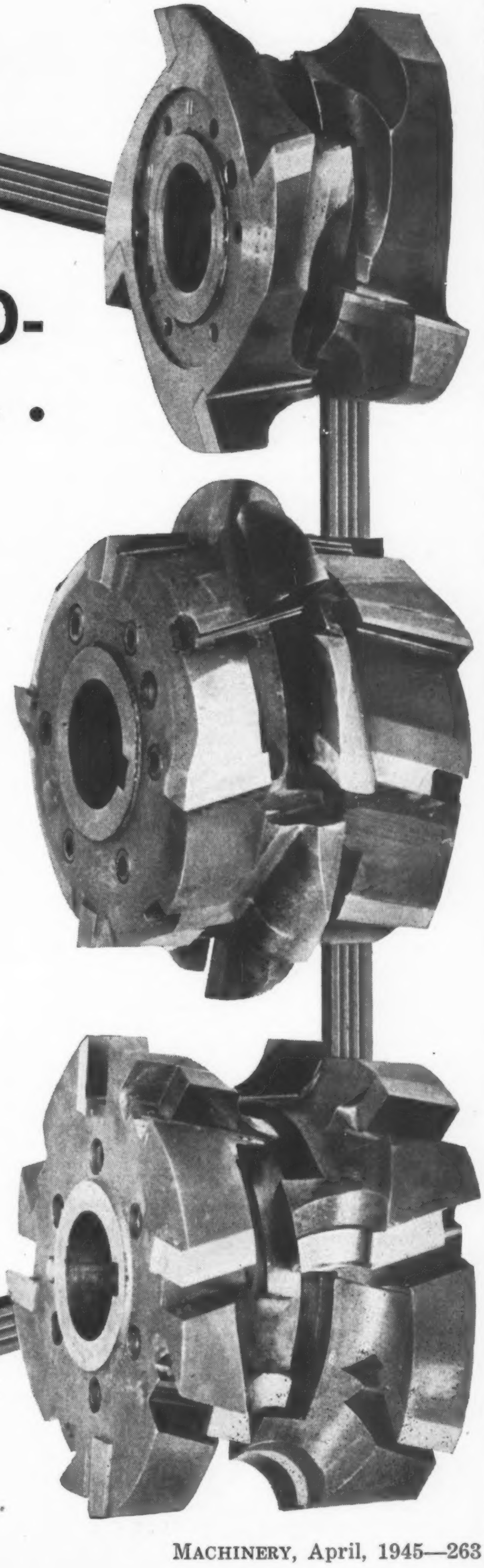
He started work in the foundry field as a molder with the Ohio Malleable Iron Co., and after a period of service

Byron H. Newell

in the first World War, re-entered his chosen field. In 1934, he entered the employ of the Buick Motor Co. as foundry superintendent, and in a few years was promoted as assistant general superintendent. In 1941, he became general superintendent, and in the fall of 1942, was appointed to the post that he held at the time of his death. Mr. Newell was a native of Columbus, Ohio, and was a graduate of the Ohio State University. He is survived by his wife and two brothers.

Morris G. Himoff

Morris G. Himoff, secretary of the Morey Machinery Co., Inc., New York City, died at the home of his daughter in Belle Harbor, N. Y., following a heart attack on February 17. Mr. Himoff would have celebrated his sixty-eighth birthday on February 22. He came to this country from Odessa, Russia, as a very young man. To fur-



ther his education, he attended night school while working in a bicycle repair business with his brother. Later he developed cigarette-making machinery and general tobacco-cutting machinery to a point where he became one of the best known figures in that industry.

Mr. Himoff has been a member of the firm of Morey Machinery Co. since its inception, and was extremely active in the development of various machines manufactured by the company. He is survived by his wife, three sons, all of whom are serving or have served in the armed forces, and one daughter.

C. G. Brockman, president of the Smith & Mills Co., Cincinnati, Ohio, since January, 1943, died at Christ Hospital in Cincinnati on Monday, March 12, after a long illness. Mr. Brockman was fifty-seven years old. He had been with the Smith & Mills Co. for a period of about thirty years. He is survived by his wife, Jessie, and by two brothers, William and Harry Brockman.

Coming Events

April 4-6—National Aeronautic Meeting of the Society of Automotive Engineers at the Hotel New Yorker, New York City. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York 18, N. Y.

June 18-22 — Forty-eighth annual meeting of the American Society for Testing Materials at the Hotel Statler, Buffalo, N. Y. C. L. Warwick, secretary-treasurer, 260 S. Broad St., Philadelphia 2, Pa.

October 1-3 — Fall meeting of the American Society of Mechanical Engineers in Cincinnati, Ohio. C. E. Davies, secretary, 29 W. 39th St., New York 18, N. Y.

November 26-30—Annual meeting of the American Society of Mechanical Engineers in New York City. C. E. Davies, secretary, 29 W. 39th St., New York 18, N. Y.

* * *

Those who can see only the big figures of industrial profits do not realize how much expensive and discouraging research work may have preceded the final practical solution of an engineering or chemical problem. High-octane gasoline, one of the secrets of the success of American aircraft, is the result of thirty years of research. More than 33,000 separate compounds were tried before the right one was found.

New Books and Publications

Aircraft Mechanical Drawing. By D. J. Davis and C. H. Goen. 245 pages, 5½ by 8½ inches; profusely illustrated. Published by the McGraw-Hill Book Co., 330 W. 42nd St., New York 18. Price, $2.50.

This mechanical drawing course has been prepared for the student who has had no previous instruction in the subject. To be able to benefit by the book, however, he should have a good grounding in arithmetic and elementary algebra, and in addition, should have some knowledge of geometry and trigonometry and an acquaintance with manufacturing processes. The knowledge of mechanical drawing gained from a conscientious study of this course will serve as a background, enabling the student to make detail drawings and thus qualifying him for work in an aircraft engineering department. The book covers drafting tools and instruments, lettering, projection, sections and auxiliary views, dimensions, mathematical principles, and the elements of descriptive geometry. A brief review of manufacturing processes is included.

Applied Fundamentals of Machines. By Wendell H. Cornetet and Daniel W. Fox. 323 pages, 6¾ by 10¼ inches. Published by McKnight & McKnight, 109-111 W. Market St., Bloomington, Ill. Price, $2.50.

This book is one of a series prepared to provide special war courses in practical science and mathematics. These books are designed for day school or evening classes, and give the necessary background for the specialized occupations required by modern armed forces, as well as in present-day industrial plants. The purpose of this book is to teach the basic principles of machines and to show important industrial applications of fundamental theories through experiments and demonstrations. The material is arranged in units of study, with references to many standard texts. There are also assignment units to instruct the student in the proper methods of procedure for each job encountered. The book constitutes a combined text, manual, and notebook.

Manual of Broaching. 83 pages, 8½ by 11 inches. Published by the Detroit Broach Co., 20201 Sherwood Ave., Detroit 12, Mich. Price, $1.50.

This manual of broaching covers the design and use of all types of internal broaches, faceplates, and broach-pullers. It discusses the principles of surface broaching and shows many examples of typical broached parts. One section is devoted to fixtures and another to broach-holders and inserts. The various types of broaching machines are described, and information is given on their advantages for particular types of work. A section is included on the setting up, operation, and maintenance of broaching equipment.

A Remarkable Attendance Record

The recent death of Herbert Van Wynen, an expert in the assembly of safe deposit locks with the Yale & Towne Mfg. Co., Stamford, Conn., ended one of the most remarkable records for punctuality and faithfulness in the performance of duties ever met with in American industry. For more than forty-nine years, in spite of rugged New England winters and notwithstanding the fact that his home in Old Greenwich was located five miles from the Yale & Towne plant, he was never late and never absent from work. Mr. Van Wynen was sixty-nine years old at his death and had been with the Yale & Towne organization since the age of seventeen. His record for punctuality and attendance dates back to 1896.

Mr. Van Wynen was highly thought of, not only by the executives of the company that he so faithfully served, but also by his fellow workers, as evidenced by the fact that they elected him for fifteen consecutive years president of the Bank Lock Department Social Club, in which he took a leading part in programs of entertainment and in welfare activities. He was as interested in civic welfare projects in his home town as he was in plant activities; among other things, he helped to organize and operate the Greenwich Fire Department.

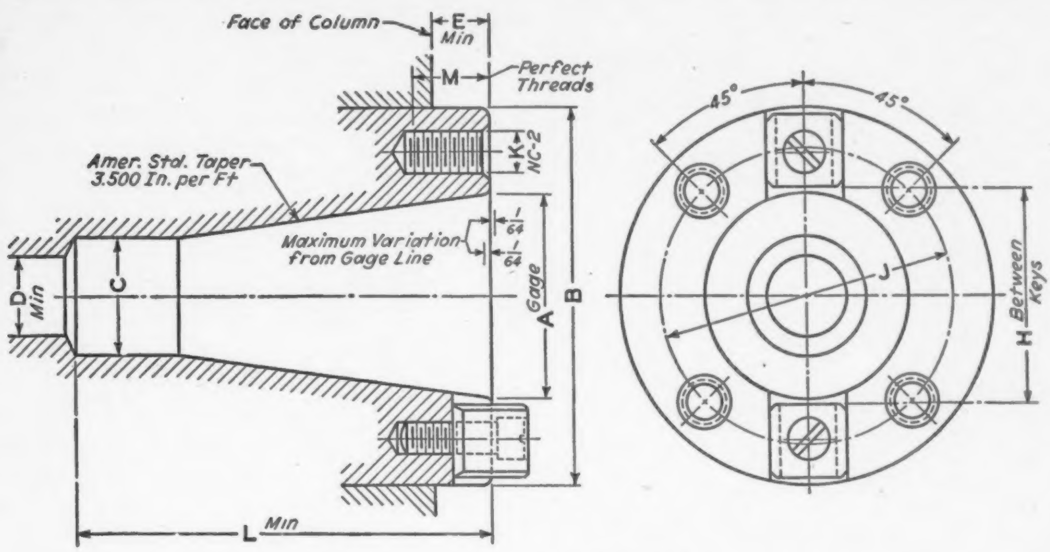
* * *

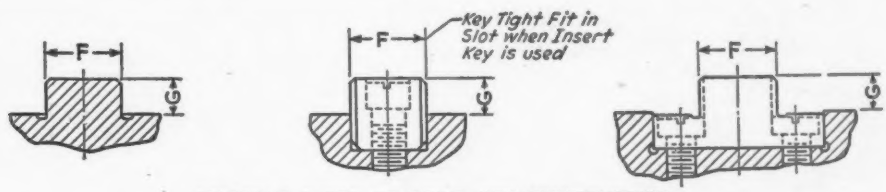
The Central Aircraft Council, consisting of a group of engineering and production executives in the aircraft and automotive industries, recently held a meeting at the plant of the Pangborn Corporation, Hagerstown, Md. The session was devoted to a study of shot-peening. Many samples of work were submitted for test runs on the Pangborn Rotoblast shot-peening table set up in the demonstrating laboratory. Finished work was displayed with production data for studying peening intensities, arc height tests, coverage, and peening time.

MACHINERY'S DATA SHEETS 535 and 536

SPINDLE NOSES AND ARBORS FOR MILLING MACHINES*—1

Approved by American Standards Association November, 1943





SELECTIVE TYPES OF DRIVE KEY CONSTRUCTION

MACHINERY'S Data Sheet No. 535, April, 1945

*For dimensions, see Table 1, Data Sheet No. 536.

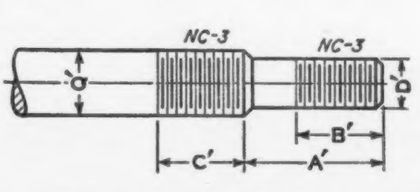
SPINDLE NOSES AND ARBORS FOR MILLING MACHINES*—2

Approved by American Standards Association November, 1943

Table 1 Essential Dimensions of Spindle Nose

Size Number	Gage Diameter of Taper A	Diameter of Spindle Flange B	Pilot Diameter C	Clearance Hole for Draw-In Bolt, Min D	Minimum Dimension Spindle End to Column E	Width of Driving Key F	Height of Driving Key G	Distance Between Driving Keys H	Diameter of Bolt Hole Circle J	Size of Threads for Bolt Holes K	Full Depth of Arbor Hole in Spindle, Min L	Depth of Perfect Thread for Bolt Hole M
30	1 1/4	2.7493 2.7488	0.692 0.685	21/32	1/2	0.6255 0.6252	5/16	1.315 1.285	2.130 2.120	3/8–16	2 7/8	5/8
40	1 3/4	3.4993 3.4988	1.005 0.997	21/32	5/8	0.6255 0.6252	5/16	1.819 1.807	2.630 2.620	1/2–13	3 7/8	13/16
50	2 3/4	5.0618 5.0613	1.568 1.559	1 1/16	3/4	1.0006 1.0002	1/2	2.819 2.807	4.005 3.995	5/8–11	5 1/2	1
60	4 1/4	8.7180 8.7175	2.381 2.371	1 3/8	1 1/2	1.000 0.999	1/2	4.819 4.807	7.005 6.995	3/4–10	8 5/8	1 1/4

All dimensions are given in inches.



Draw-in Bolt used with Arbor shown on Data Sheet No. 537

Table 2 Dimensions of Draw-In Bolt End

Size Number	Length of Small End A′	Length of Perfect Thread at Small End B′	Length of Perfect Thread on Large Diameter C′	Size of Thread for Large End Q′	Size of Thread for Small End D′
30	1 1/16	3/4	3/4	1/2–13	3/8–16
40	11/16	11/16	1 1/8	5/8–11	1/2–13
50	1 1/2	1 1/4	1 3/8	1–8	5/8–11
60	1 3/4	1 3/8	2	1 1/4–7	1–8

All dimensions are given in inches.

MACHINERY'S Data Sheet No. 536, April, 1945

*For details, see drawing Data Sheet No. 535.

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